

# BULLETIN OF MISCELLANEOUS INFORMATION No. 2 1930 ROYAL BOTANIC GARDENS, KEW

## VII.—A BOTANICAL EXPEDITION TO PERSIA.

J. M. COWAN.

A proposal for a botanical expedition to Iraq and Persia put forward by the Director of the John Innes Horticultural Institution, Merton, early last year appeared to be one with which Kew could be very profitably associated.

With the concurrence of the Empire Marketing Board and the Ministry of Agriculture and Fisheries, it was arranged with Sir Daniel Hall that Dr. J. M. Cowan, a temporary member of our staff, should accompany Dr. C. D. Darlington from Merton, and that the Expedition should be a joint one.

The selection of Dr. Cowan for this interesting expedition proved to be a very fitting choice, since in addition to being a keen botanist, he is a traveller of experience, a qualification which, as may be gathered from the following narrative, is essential for anyone attempting to carry out journeys in Persia.

Dr. Cowan has prepared the accompanying general account of the tour, in the course of which he received every assistance from H.M. Consuls and others, to whom grateful thanks are offered for all their kindness.

Valuable collections of living bulbs of Tulips and other plants have been successfully brought home as well as living specimens and seeds of plants of economic interest, and a very important collection of Herbarium material\* which is now being identified by Dr. Cowan.

This further opportunity of being able to send a competent botanist to explore and collect in a region likely to yield plants and information of value to the Empire, has been rendered possible by the grant of the Empire Marketing Board to Kew.

A. W. H.

At the time of our departure for Persia, the whole of Europe was locked in snow and a journey by train even to Marseilles was an uncertain adventure. There was thus no choice in the selection of a route for we had to arrive by a definite date in Damascus, so, leaving London on February 22nd, 1929, we travelled by sea via Gibraltar to Port Said.

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\*The collection is deposited in the Herbarium at Kew. The serial numbers given after botanical names in this account refer to the collector's field numbers of this collection.



Dr. Cowan's route on his botanical expedition through Persia.

## PALESTINE.

The Sinai desert was crossed by night. As the train passed through Southern Palestine in the early morning, it was interesting to note some of the changes that had taken place since I had been there during the war. The most striking feature was the great increase in the number of Jewish Settlements in the course of the last ten years. Fleeting glimpses showed, not only scattered villages as of old, but many solitary homesteads, a fact which is noteworthy as evidence (in spite of recent disturbances) of the more settled condition of the country. The settlers appeared to be prosperous and, under the new conditions, the land is naturally more intensely cultivated than under the old and its fertility seems to have considerably increased. Orchards and orange groves have expanded and planting is progressing rapidly. The main difficulty that growers have to contend with is, I was told, the marketing of their fruit. It is claimed that the greater part of the profit goes into the pockets of middlemen, and attempts are now being made to organise a more direct system of selling so that the Jaffa orange may obtain the popularity it deserves.

Another striking feature of the general development of the country is the great improvement in communications. Many of the roads, formerly unmade tracks, have been converted into highways permitting fast travel at almost every season.

It was disappointing not to have time to revisit some of these localities; and I should have liked also to see something of the afforestation work which has been undertaken. The route we followed, however, gave no opportunity of witnessing development in this direction.

The sand dunes along the coast which were rapidly encroaching upon fertile agricultural land appeared to have advanced, in some places considerably.

On the limestone hills the creation of forests must necessarily be slow, yet there are areas where, with the help and sympathy of the local population, timber might be grown without much initial preparation of the soil. As far as could be seen, however, conditions in the region traversed were much the same as they were during the war.

The road over the Lebanons being blocked by snow, we proceeded from Ludd (Lydda) to Jerusalem by train, and from there by car, a delightful journey to Tiberias, along the shores of the Sea of Galilee and then across the Jordan into Syria and on to Damascus.

We were too early to see the hillsides a blaze of colour with spring flowers, but there were here and there purple tints where the common Cyclamen, *C. latifolium* Sibth. & Sm., and a small *Erodium* were just coming into flower, also a few patches speckled red with the Syrian Poppy.



## DAMASCUS TO BAGHDAD.

The journey across the Syrian Desert from Damascus to Baghdad, a distance of 533 miles, was made in the Nairn Desert Transport 65 h.p. Safeway Coach.

Although the traveller is regaled, before starting, with harassing tales of cars that have come to grief or disappeared, there is actually nothing, beyond the discomfort of two days' continuous violent jolting, that would upset even the most timid traveller. When the first ten miles of the journey are accomplished, the fields and Date Palms of Damascus have been left behind and the bleak, arid hills to the north of the city are quickly receding. Onwards, as far as Ramadi, there is nothing but desert.

Having crossed a dry sandy stretch of country we came, somewhat suddenly, to a region where rain had obviously fallen within the past few days. The general colour of the landscape changed from a sandy to a greenish-yellow, owing to large irregular patches of vegetation. Throughout the Syrian Desert the rainfall apparently varies considerably, for arid sandy belts alternated with greener stretches and at one point there was, in fact, a distinct line which marked a very recent fall of rain. Taking the whole desert journey, it was not the barrenness of the land so much as the extraordinary amount of vegetation that was its most striking feature at the time we crossed. It was evident too that the spring herbage cannot be so meagre as might be expected, for it supports, for a time at least, vast numbers of cattle and seems to maintain them in good condition. During the first day's journey we passed through a whole series of Bedouin encampments, which spread out before us continuously for an hour, until we had covered a distance of 40 miles. There were camels by the thousand, sheep, goats, donkeys and Arab ponies, all in every shade of colour from pure white to jet black. While passing through this well-grazed area we saw in the distance a small lake, about a mile long. It was the only real stretch of water we passed in the desert, although one mirage after another preceded us for most of the way.

During the twenty minutes' halt for lunch, I was able to examine some of the vegetation more closely, and in this short time collected some sixty species in flower. They were scattered in small irregular groups often with considerable intervals between each plant and with wide blanks between the groups. Many of the plants were only from half an inch to one inch high. The groups were composed of mixed associations, Composites predominating. The most striking of these was the minute, orange-flowered *Calendula persica* C. A. Mey. There were several small Leguminous plants (*Medicago* most abundant), and Crucifers, *Arenaria* sp. and a pink-flowered *Erodium*. *Iris Sisyrinchium* L. (22) occurred in small groups and a *Cyperus* sp. in larger patches, both gregarious. The main fodder grass was *Poa bulbosa* L. (II). A number of species were remarkable on account of their grey foliage, amongst these being *Filago prostrata*

Parl., *Plantago Loefflingii* L., *Ceratocephalus falcatus* Pers. and the curious button-like *Odontospermum pygmaeum* Hoffm. (1), sometimes known as "the Rose of Jericho."

Part of the night of March 9th was spent at Rutbah, a stone-built fort, and Ramadi was reached the following afternoon. From here across the Euphrates to Baghdad and the Tigris the landscape is relieved by scattered wheat fields and the horizon is broken by groves of Date Palms.

For a week (March 10th to 17th), we remained in Baghdad, awaiting the arrival of equipment from Busra and were much indebted to Mr. J. F. Webster, Inspector-General of Agriculture, for help with final arrangements and in negotiating the maze of formalities that have to be gone through ere Persian territory may be entered. Two pleasant afternoons were spent collecting round Baghdad and as far as Ctesiphon, with the Rev. F. A. Rogers, and several visits were paid to the Agricultural Farm and College at Rustam, where we enjoyed the hospitality both of Mr. F. K. Jackson and of Mr. D. D. Patterson, the Principal. One afternoon I spent with Mr. Jackson looking over and arranging the local herbarium at the College, which contains an excellent representation of the local flora.

But Baghdad, even in March, is not an alluring city. The glare of the sun-dried bricks is trying, and walking and driving is none too pleasant on account of the impossibility of moving about without inhaling large quantities of the local dust. It was surprising to find within the city no public parks or gardens. Of the one miserable playing ground for children, recently opened, the municipality, judging from the local newspaper, is inordinately proud.

The banks of the Tigris, with its long vistas and cooling breezes, offer so much scope for these amenities, which are usually regarded as necessities under much less trying conditions of climate, that it seems extraordinary that the more enlightened of the local population have not yet come to appreciate the value of civic "lungs." What trees there are in the city are dust-covered, and the exotics struggling to maintain life in private gardens look very sad.

For the tour through Persia a 30 cwt. Ford Truck of the new type, sent out from England, was the means of transport used. In spite of steep gradients and of roads often no better than a ploughed track, the truck did its work efficiently; in fact, by no other means of transport could so much have been accomplished in the time. We travelled 3,500 miles in the lorry, and, using it as a base, made excursions by pony, mule or on foot, another 400 miles.

#### BAGHDAD TO KHANIQIN.

From Baghdad to Khaniqin on the Iraq frontier the first part of the way is flat. The soil is a heavy alluvium and about Baghdad the greater part of the country is irrigated and carries crops of wheat and barley. The commonest weeds in the fields are the familiar *Lepidium Draba* L., *Malva rotundifolia* L., *Reseda decursiva*



Forsk. (211), *Camelina* sp. and *Capsella Bursa-pastoris* L., with several bulbous *Muscari* and *Ornithogalum*. Seven miles from the city the last of the cultivated land is reached; the track then runs through arid country, near the railway for part of the way, and passes only an occasional village.

In the vicinity of Khan Bani Sa'ad, date palms become an important feature on the horizon and near here a small swamp was passed with surrounding *Juncus*, and with masses of *Ranunculus aquatilis* L. in the water.

After 65 miles of level ground the Jebel Darawishka range had to be crossed, the lower slopes of which carry a dwarf vegetation, very similar to that of the Syrian desert. Just as we were descending the Khaniqin slope of this barren-looking range of hills, we made the most interesting find of the day, a fine yellow Tulip with a black centre. To collect about a dozen bulbs we had to get out our mining tools, for the ground was exceedingly hard and stony and the bulbs a foot or more below the surface of the ground. To trace the slender white stem which led down to the bulb, without cutting it, was no easy matter.

The night of the 18th March and the following morning were spent in Khaniqin, Mr. F. Haire of the R.F.A. being good enough to accompany me as guide on a short excursion. Although we did not again find the yellow Tulip, there were many other plants already in flower. The frontier was crossed in a dust storm, visibility being just good enough to discern above the road two solitary trees which seemed out of place in these arid surroundings.

#### PERSIAN FRONTIER TO HAMADAN.

To the Persian plateau from Kasr-i-Shirin is a climb of about 5000 ft. The slope is fairly steadily upward for 35 miles. Patches of cultivation and rolling plain with wide stretches of arable land soon replace arid conditions. There are several steep ascents, the last and most formidable being the Pai Tak which is negotiated by a series of hairpin bends. When we reached the top, winter conditions prevailed, the distant hills were covered with snow, what trees there were were leafless and there was as yet no sign of spring flowers. From the top of the Pai Tak pass there is a short descent with scattered Oak scrub on either side and then the Karind Plain is entered. This is the first of a series of plateaus often thirty or forty miles or more in length, and fifteen to twenty miles in breadth, which characterise the country as far as Teheran. These wide plains lie at altitudes varying from 3000 to 6000 ft. and are separated by steep ranges of hills which have to be crossed by zig-zag tracks.

Kermanshah, which lies in the centre of the plain of the same name, at an elevation of 4500 ft. above sea level, is flanked by mountains snow-capped in the early spring, not unlike the Spanish Sierra Nevadas. Our stay here was longer than we had anticipated, for we had arrived at the beginning of the Persian New Year celebrations and had to leave our goods for a week in bond, learning

that the first requirement for an extended tour in Persia is an infinite patience.

An exceptionally cold spell just before our arrival had set back early growth, and we found few plants to collect, the ground being for the most part almost bare except for scattered clumps of the withered shoots of *Euphorbia Myrsinites* L. (343). Several excursions were made, to Tak-i-Bustan, to Lake Nil-i-Nuphar with M. Moreaux of the Customs department, and in other directions.

The whole of this part of Persia is treeless except round towns and villages where small plantations are often found along the banks of streams. The species usually planted is *Populus euphratica* Oliv., occasionally *P. alba* L., less seldom Willows, and 'Sangit' (*Elaeagnus angustifolia* L.).

I was astonished to find that the methods adopted in establishing these plantations would do credit to a well-trained forester. At Kermanshah the plantations were typical. The main stream, which ran along a narrow valley, was tapped by a permanently flowing artificial water channel, four feet wide and two feet deep, which had been constructed along the hillside on the contour. Along both banks of the channel Poplars had been planted. Parallel to this permanent water course, at four feet intervals down the slope to the stream at the bottom of the valley, shallow trenches had been dug and the ground was roughly terraced. Along one side of each trench a row of seedlings had been planted so that, to irrigate the successive rows, all that was necessary was to break the bank of the channel above and to allow the water to flow down and along each contour trench in turn. The original planting had been done closely at a spacing of about six inches. No actual thinning was made but the method of felling had very much the same effect as an *éclaircie par le haut*. The fastest growing poles reached a height of 25 to 30 feet and a diameter of about 9 inches in 14 to 15 years and were then removed. The least vigorous stems were by this time suppressed. Thus the commercially mature plantation, at the age of about 20 years, consisted of a fine stand of straight poles from a foot to eighteen inches apart in the woods. Further there was in the small area planted a series of age classes, which would maintain a permanent supply of straight poles. These constitute the chief demand for timber, since in a Persian village the houses are flat roofed and when the walls have been taken to a height of about eight feet, the rafters, invariably round untrimmed poles, are laid down at intervals of one foot to eighteen inches. They are covered by bundles of faggots or roughly split batons laid at right angles to them. A layer of rubble is laid on top and the roof is completed by adding a coating of mud. Thus none of the timber is wasted, though its use is confined to roofing and the making of agricultural implements, the local fuel being cow or camel dung. For these poles, transport, always a difficult matter in Persia, is provided by donkeys. The load varies from two to six poles per animal, crossed near the



butt-end and lashed to the pack saddle. The thin ends of the poles splay out and drag along the ground, the donkey being at the fulcrum of his scissor-shaped load.

It was our intention to proceed northwards from Kermanshah by the Senneh road and to make excursions towards the frontier. North of Senneh, however, the Persian army was engaged in a war with the Kurdish tribes, in an attempt to disarm them, and we were unable to obtain permission to proceed by this route. "A fool who collects weeds" might have some ulterior motives.

By the 29th March we had overcome customs difficulties and left Kermanshah meaning to proceed southwards to Sultanabad and Isfahan in order to encounter warmer weather. The road took us by the great rock of Bisitun, which rises almost vertically 5000 ft. above the plain, and we stopped frequently to collect but found little. At Kangavar a passing motor driver warned us not to attempt the direct road to Sultanabad so, recognising that a prearranged programme in Persia is for ornament rather than use, we took the longer route by Hamadan. This necessitated crossing the Asadabad pass at an altitude of 7300 ft., but the road was fortunately free from snow, although large snow drifts lay all around and a bitterly cold wind was blowing near the summit.

We had only descended a short distance when suddenly to our astonishment we discovered a large number of Crocuses in full bloom. Amongst them were two Irises, one *Iris reticulata* Bieb. (336) with pale blue petals speckled a darker blue and with a yellow spot, and another a species of the *Oncocyclus* group. Tulips, *Muscari*, *Allium* and *Ornithogalum* were abundant, but the first green leaves were only just appearing above ground. At last we had reached a paradise for collectors, for the whole hillside, whether the land was bleak and waste or more sheltered and ploughed for cultivation, was green-dotted with these young plants. Earlier disappointments were forgotten and we had collected a goodly number of bulbs before darkness and a heavy downpour compelled us to hurry on to Hamadan. But already we had decided that we must wait over for a day or two and explore this neighbourhood more thoroughly.

To Mr. Davis, Vice-Consul at Hamadan, who next morning rescued us from our so-called hotel, we were truly grateful. With him we made a number of excursions, one to Mt. Alvand, where we reached a height of about 8500 ft. before being stopped by snow. Here again there were in some places many bulbous plants just breaking through the earth, but at this season much of the ground was quite bare and everywhere the soil was very stony. On many of the slopes low bushes of a spiny *Astragalus* were scattered at intervals of 20 or 30 feet, and on others a semi-herbaceous *Salvia* and the remains of a *Euphorbia*. All these plants were of a dark brown colour and, having recently lost their winter shroud of snow, as yet showed no signs of new growth. Looking down into the main valley which leads up from Hamadan we could see on the lower



slopes tall poplars standing leafless and conspicuous with their white bark, and above them, on the higher slopes, willows with bright red twigs, a fine picture in contrasting colours. Nearer Hamadan almond and apricot orchards had been planted in the valley and the whole ground was carpeted with a deep blue *Muscari*, a wonderful natural colour scheme, which would be well worth imitating in gardens.

#### HAMADAN TO ISFAHAN.

An attack of influenza unfortunately kept me for a few days in Hamadan, but by the 11th April I was able to be out again, and by this time the poplars and "Chanars" (*Platanus orientalis* L.) on the roadsides and in the gardens were yellow and green with their young foliage and in the orchards the almonds and apricots were in blossom. We left Hamadan on the 16th April for Sultanabad, spending the greater part of that day on the mountains near the village of Neshar where, under the guidance of an old man who skipped about with the agility of a young goat, we collected large numbers of Tulips, red, yellow and white, *Fritillaria imperialis* L. and other species. At Sultanabad we spent the night with the British Vice-Consul, Mr. Hutton and his wife. The collections made by Mr. R. Strauss, his predecessor, from this part of Persia are well-known.

Thanks to the energies of Mrs. Hutton we were able to satisfy ourselves that excellent wine can be made from the grapes of the country if care is taken in the manufacture. Since the Mohammedan religion forbids its followers to taste of the fermented grape, wine in Persia is usually made by Armenians; it is often difficult to obtain, and is of poor quality, being, as a rule, extraordinarily acrid. In one locality we were told that 72 varieties of grapes are grown, principally for raisins. The vineyards, however, looked so neglected and the system of pruning so haphazard that the crops obtained must be very much smaller than would be possible with better methods. When transport conditions have been improved and there is greater facility for export, and markets other than the Russian are organised, there is no doubt that this industry will become much more important than it is at present.

Leaving Sultanabad by the road to Qum we turned aside at Ibrahimabad to Emrabad. Here for several miles the plateau is covered with tufts of *Gladiolus atrovioleaceus* Boiss. (599) scattered about at intervals of 1 to 2 yards, the only other frequent species being a *Euphorbia*. Consociations such as this, with a single dominant species, are typical of large areas on the arid or semi-arid Persian plateaus. Further south a *Salvia*, in evenly distributed clumps 2 to 3 ft. in diameter and 1 to 2 ft. high, with a drab foliage closely resembling the colour of the soil, is the dominant plant.

In other areas, *Cleome coluteoides* Boiss. (568), with a pungent and objectionable odour, forms consociations. Elsewhere species of *Euphorbia* are dominant. North of Isfahan the vegetation of

considerable tracts of country is characterised by *Artemisia* sp. Again, *Peganum Harmala* L. is widespread over other areas.

On hilly ground, and over a great extent of the plateaus also, there are mixed associations, with Composites (the genera *Senecio*, *Achillea*, *Anthemis*, *Matricaria*, *Tragopogon*, *Saussurea*, predominating), Crucifers (especially *Alyssum*), *Roemeria*, *Acantholimon*, *Silene*, *Reseda*, *Linum*, *Geranium*, *Euphorbia*, *Tulipa* and *Muscari* as the plants most frequently encountered.

When we had shown our passports and given our fathers' names and a brief autobiography to the police, a precautionary measure against brigands, we were allowed to enter the city of Isfahan. Here we were royally entertained at the Consulate by Mr. and Mrs. Bristo. Their garden is one of the finest we saw in Persia. The green lawns near the entrance are lined with Cypress trees, and a water pool in the centre gives it something of the appearance of the gardens of the Taj Mahal in miniature. Further back are some tall specimens of Pines, and several Oriental Planes, and a number of fine *Robinia Pseud-acacia* trees bearing enormous hanging clusters of cream-coloured flowers. In the flower beds Petunias were the most flourishing of the exotics, their growth being so vigorous that they were regarded almost as weeds.

In Isfahan a good deal of time had to be spent in drying and packing our collections, but one excursion was made to the village of Kehnu on the borders of the Bakhtiari country. Here I was the guest at lunch of the headman of the village and of one of the "gulams" from the consulate and we supped in Persian style. I saw something of the local agricultural methods and the skilful layout of the fields to facilitate irrigation.

For conducting water to the area, two methods are in general use; an open channel or "jub," and an underground tunnel or "kanat." The "jub" starts from a stream, the "kanat" from a water-bearing *stratum* in the hills, possibly many miles from the locality where the water is required. Along the line of the tunnel wells are dug at intervals which vary according to the nature of the soil. Near the starting point they are said to be sometimes as much as 500 ft. deep. The men employed to do the excavation have a wonderful sense of direction and seldom go astray when tunnelling from one well to the next.

By the mouth of each well there is a huge mound of earth, and long lines of these may be seen in many parts of Persia. An astonishing amount of work is put into the construction and maintenance of these "kanats." Each year the tunnels have to be cleared and this is done by parties of men working in pairs. A windlass is erected over the mouth of each well in turn, and while one man is let down by a rope and works below ground, his companion remains at the surface to haul up the bucketsful of mud collected.

The principal crops grown are barley, cotton, opium and mustard. Two crops of barley are sown, one in the autumn and one in spring. Five or six months are required from the time of sowing



till harvest and the land is irrigated at intervals of 40 days. The Opium Poppy is sown with Cotton and *Kalashu*, a kind of garlic, the Poppy being harvested before the Cotton matures. Mustard requires 7 to 8 months to ripen and the oil is used for lighting and as a lotion for applying to the backs of camels. A press of a kind I had not seen before was used for extracting the mustard oil. In a dimly lit cavern three long tree trunks were lashed securely one above the other ; their length was about thirty feet and the diameter of the largest over four feet. The butt ends of these enormous boles were let into a recess in the end wall some four feet above ground level, while the narrow ends were hoisted, by a primitive derrick, fifteen feet to the roof of the building. The mustard seed was laid in a hole in the ground a foot or two from the wall and above it a log, the size of a butcher's bench, was placed vertically under the main boles. Other logs were added to fill in the gap and were jammed fast with wedges driven by a heavy mallet. Then the windlass was allowed to turn, the trunks descended from the roof, giving a tremendous pressure, and the oil that oozed out was collected at a point six feet below the surface of the ground, to which a well gave access.

With seven enthusiasts from the village, who were enjoying a lorry ride for the first time, a collecting expedition was made to a range of hills fifteen miles away. No car could have been expected to go over worse country and it was only possible by the ease with which the load could be converted into additional power. After a fairly successful time we returned to Kehnu after dark, and instead of proceeding to Isfahan, I was the guest for the night of the headman, who provided all necessities. I slept comfortably, for the village was well walled and it was five years since the last raid, in which 65 of the inhabitants were massacred.

#### ISFAHAN TO TEHERAN.

From Isfahan to Qum we had retraced our track as far as Dilijan and, with numerous halts for collecting, were able to cover the 174 miles to Qum in our longest single day's journey. On the other hand, a week or two later, it took us seven hours of hard work to cover four miles; such is motoring in Persia. Qum was visited with the object of obtaining, if possible, cuttings of a seedless Pomegranate which was known to grow about there. After a long search we were successful in finding it, and although most of the Pomegranate trees in the orchards had been killed by a phenomenal frost earlier in the year, we were fortunate enough to secure cuttings. A few days later they left Teheran by air mail, and arrived safely at Kew, where the *anare behaste* or "Pomegranate of Paradise" is now growing. It may be interesting to add a note as to the method of culture of the Pomegranate. It is propagated by cuttings, and trees are planted at approximately eight feet intervals. During the whole of summer the land is irrigated every six days. The soil is tilled in the early spring, being turned over to a depth of about

two feet. Using long-handled spades four men dig together. They raise their spades simultaneously and plunge them close together into the ground. A wooden footrest near the base of the spade enables them to apply pressure by jumping upon it as they drive in the spade. Then together they lift the heavy sod and toss it into the air so that it is partly broken in falling. The whole operation is then repeated. There is apparently no timekeeper, yet the men work in complete harmony and cover the ground at an astounding pace. After digging, barley is sown as a catch crop and is harvested before the Pomegranates ripen.

In Teheran my time was fully occupied for four or five days despatching collections homewards. This is not the simple business the uninitiated might be led to expect—the process had the horrors of a recurring nightmare, and I was grateful to those at the Legation, especially to Mr. Henderson, who made matters easier.

Sunday was spent as the guest of Sir Robert Clive, at Gulahek, in the Legation garden. I had the pleasure also of meeting Dr. Sayid Khan, who assisted me with the purchase of seeds and drugs and lent me several interesting old Persian illustrated Herbals.

From Teheran, had time been available, we should have travelled as far as Asterabad on the Caspian Sea, but a wire to Tabriz brought the reply that the spring flowers were already beginning to appear, so we hastened towards the less-known regions round Tabriz and Urumia.

#### TEHERAN TO TABRIZ.

We left Teheran on May 2nd, and were impressed by the greenness of the vegetation and greater density of the population as compared with the more arid tracts further south. As far as Kazvin, it was rare to be out of sight of a habitation. To the north lay the Elburz Range from which numerous streams run down to the plain. This accounted for the fertility of the district, for much of the soil in Persia requires only water to convert it from barren into fertile land. The streams at the same time do a good deal of damage during flood, leaving wide stony beds, just as may be seen along the foothills of the Himalayas on a much larger scale.

On waste land the outstanding plant was the Cistus-like *Hulthemia persica* Bornm. (856) with bright yellow petals and a dark brown centre. It is a low spiny shrub, not as a rule exceeding one foot in height, but covering altogether many acres.

After Kazvin we left the road and took to a mere track, indicated by the line of poles of the Indo-European Telegraph. Our pace was reduced to 10 m.p.h., punctuated by frequent pauses to negotiate ruts and cross drains, and by sudden spurts when the surface for a moment would permit of some acceleration. Zinjan lies near the point of two approaching ranges of hills. From Zinjan we followed the Zinjan Rud more or less closely for a distance of about seventy miles, the country becoming again more arid. It was no longer necessary to negotiate the famous Kuflan Kuh, up which



cars had to be hauled by a capstan, for a new road had been built. Here we found a most striking Crucifer, *Aethionema pulchellum* Boiss. (712). It grew in shrubby cushions, 2 to 3 feet in diameter, and these were dotted all over the hill-side, each cushion a marvellous blaze of pinkish-purple. Another conspicuous plant in the same locality was an orange-coloured *Glaucium*.

By the time we were approaching Mianeh we had descended to an elevation of 3000 feet and became aware of the change from temperate to semi-tropical conditions, not only by the rise in temperature but by the presence of rice fields, with buffaloes ploughing as in India. The plain of Mianeh is exceedingly fertile and stretches for nearly twenty miles. Rice is the principal crop grown and there is no shortage of water, which comes from the river, Kizil Uzin, which we crossed by a stonework bridge with 23 arches.

Without calling a halt in the village of Mianeh, which has gained a reputation on account of its specially noxious bug *Agras persica*, we climbed again out of the plain and spent the night at Suma. This is a delightful little village recalling Avon-side haunts in Banffshire. Near our hut was a fast-flowing brook making a pleasant song, beautiful green grass and Buttercups, and in the distance Poplar trees, Willows and a rustic bridge spanning the stream.

From Suma the road is a series of zig-zags up and down with 47 rivers to ford in the valleys. Near Yusufabad we passed a fresh-water lake, and having negotiated the perilous-looking ascent and descent of the Sibilik Pass, were in well-irrigated country with row upon row of pollarded Willows. After a few miles of more barren country we arrived at Tabriz, having completed the 400 mile journey in five days. In Tabriz we were entertained most hospitably by Mr. Gilliat-Smith, who is himself a keen botanist and has sent valuable and interesting collections from the Tabriz area and elsewhere to Kew.

#### AROUND LAKE URUMIA.

After a two days' halt in Tabriz, I set out again (this time by myself) for Urumia, travelling via Djulfa and Khoi, reaching the Russian frontier (88 miles), in under four hours, a journey which takes two days in the Persian train! Here I turned south-west and between Djulfa and Khoi in one or two localities only, but there abundant, I found *Iris Barnumae* Foster & Baker growing profusely in small clusters. Next day, between Khoi and Urumia its so-called variety (var. *urumensis*, 1290), which has a brilliant yellow flower, was found also in one or two localities, notably on the Kushji Gadugi Pass.

To the south of Dilman the road crosses a low-lying portion of the plain of Salmas, which in recent geological times must have formed part of the Lake of Urumia. The landscape was a blaze of yellow with *Ranunculus*, recalling the Oxford meadows in early summer. Soon after our first sight of Lake Urumia we passed a ruined village, the first of many, for these are a constant feature of the district,

where there is scarcely a house that has not suffered in the war and post-war disturbances.

Mr. and Mrs. Muller of the American Presbyterian Mission, to whom I had a letter of introduction, very kindly asked me to make their house my headquarters during my stay in the district.

Excursions were made to the parts nearer Urumia, to Band and to the Lake, then several days were spent in the Mission rest house at Sir, from which the surrounding areas were explored. The road to Sir for part of the way follows the Bardeshur Chai, whose banks are lined with willows (two species), a *Prunus*, a *Fraxinus*, poplars and an occasional *Crataegus*. The lower hills have a sparse vegetation, but yielded *Capparis sicula* Duham. (1516), *Aristolochia maurorum* L. (1219), and *Orobanche* sp. parasitic on *Salvia* and on Thyme. At higher altitudes the pastures improve and the vegetation above 6000 ft. is luxurious.

There are few grasses, but Composites, Labiates and Leguminous plants are abundant. *Astragalus*, *Salvia*, *Nepeta*, *Veronica*, *Aethionema*, *Euphorbia*, *Centaurea*, and *Tragopogon*, are the commonest genera. *Linum austriacum* L., with delicate blue flowers, covers great parts of the hillside, and *Campanula involucreta* Aucher (1257) and *Ixiolirion montanum* Herb., both with conspicuous blue flowers, are also frequent. *Gladiolus atrovioleaceus* Boiss. is not uncommon on many of the slopes and several species of thyme and *Acantholimon* occur, forming small brightly coloured clumps. Among the more striking plants *Onobrychis cornuta* Desv. must be mentioned; growing in great cushions up to three or four feet wide; a group of these, covered with their pink flowers, makes a wonderful display. *Stachys lavandulifolia* Vahl. with its long purple, feathery calyxlobes is fairly common, and *Verbascum phoeniceum* L. (2261) with its remarkable bronze-coloured petals and purple filaments is rare. Comparatively few species grow gregariously, but some of the small and more sheltered hollows were yellow with the flowers of a *Ranunculus*. Here and there small patches were carpeted blue with *Globularia trichosantha* Fisch. & Mey., or elsewhere with the "forget-me-not" *Echinospermum Szovitsianum* Fisch. & Mey., graceful in appearance if not in name. Near the top of Sir Dagh the vegetation is again more sparse and the commonest plant is the fennel-like umbellifer, *Prangos ferulacea* Lindl. (1867), which is abundant enough to make green the predominating colour.

The longest and most interesting excursion undertaken in the Urumia District was to the Plains of Mergavar and Tergavar and on to the frontier hills beyond. Permission to make this excursion was withheld for some time, but eventually given on the condition that a military escort should accompany the party.

After the prolonged haggling which usually precedes the conclusion of a bargain in the East, mules and ponies were obtained at a reasonable price, and I set out from Urumia on May 16th.



As the convoy slowly wound its way past Band and on up the valley of the Berdeshur Chai we were able to scour the surrounding hills. Camp was pitched on the Plain of Dhast, near the village of Silvana, where the river bends northwards to enter the hills again. Next morning it was raining hard at daybreak, so we decided not to move camp but to explore further up the valley and the nearer hills.

A mile above camp we passed some Kurdish tents with flocks of cattle, goats and sheep, and soon the valley narrowed into a rocky gorge which made going difficult. On marshy ground there were two orchids, one *O. maculata* L., or a near relative, with spotted leaves and a large head of purple flowers, the tallest plant proving on measurement to be 2 ft. 5 in. high. Thereafter we crossed a huge snowdrift and, leaving the ponies, climbed up the mountain side. In a small valley we came across several stunted trees, and some scattered shrubs. An oak, one or two Acers, *Pyrus*, *Crataegus*, *Prunus*, *Rhamnus*, and a small shrub with a *Dalbergia*-like leaf. On a flat piece of ground, that had probably once been inhabited, we observed a walnut tree about 30 ft. high and a group of a purple-flowered *Allium*, with very large heads, standing over three feet in height. All over the hillsides there were masses of bright-coloured flowers. Among the most striking were a large Poppy very similar to the garden *Papaver orientale* L., but with pink instead of scarlet flowers, the purple *Primula auriculata* Lam. in great clumps by the marshy banks of mountain streams, a mauve *Centaurea* and a yellow-flowered species of the same genus almost equally handsome, yellow Achilleas, great numbers of shrubby Crucifers (mostly *Aethionema* sp.), pink and white thyme, purple *Nepeta* and *Salvia*, *Ixiolirion*, *Campanula*, *Linum* and *Astragalus*, not yet in flower but much like gorse, and other legumes of this and of other genera with pink, blue, yellow and magenta flowers.

Next morning we moved to Tergavar and camped close to the village of Derbend, at the foot of the hills. On the plain there was little we had not already found. I was fortunate enough to observe a solitary group of three plants of *Iris Ewbankiana* Foster, or a closely allied species, with petals of a light buff colour veined in brownish-crimson, with a spot of the latter colour in the centre of each flag.

The following day, with the son of the Haji of Hoshaku, who was ordered by his father to keep me "on his eye," I explored the hills to the west of the village up to a height of 8500 ft.

The hills which skirt the plains of Mergavar and Tergavar must surely form some of the finest pasture lands in the world, for much of the time one walks in herbage up to the knees, as if in dense meadows. Yet, although growth is so exuberant during the latter part of May and in June, the growing season is soon over. Under heavy grazing and the hot summer sun, the pasturage quickly dries up and disappears, and by July there is said to be little herbage left. Thus although the pasturage is magnificent while it lasts, the short

season favours the nomad rather than the settler. The majority of the tribes who graze these tracts are, in fact, nomadic, coming from Iraq and Turkey in great numbers during the summer, and they denude the whole country very rapidly. Further south parts of the mountain sides had already been grazed by the time we arrived, and there was little left either for beast or for botanist. Around some of the few villages on the plains attempts at cultivation were being made, but as long as unsettled conditions prevail there is no hope of much development in this direction. Even though the Persian Army is maintaining a sort of order, the villagers informed me that it was useless to grow barley, as it would be stolen to feed the troopers' horses.

We next moved southwards and camped for several nights in the Plain of Mergavar, making daily expeditions into the hills. Above an elevation of 7000 ft. snowdrifts were frequent, and from some of the higher points magnificent views of the surrounding country were obtained.

On the swampy ground close to the edges of melting snowdrifts were often found a *Colchicum* and a small *Scilla*, with flowers of a deep royal blue or sometimes white, or again white with blue veins. Under two feet of snow they were just appearing above the ground with yellow leaves, but near the edge they had grown to a length of 4 to 6 inches and were lying flat along the ground, all pointing outwards in a struggle to escape and to reach the light. As soon as the young plant was partly exposed by the melting snow it bent upwards and the young flower bud immediately began to expand. When the icy rim had quite released the plants from its grasp they stood upright and in a few hours burst into full bloom. But their splendour was short-lived. In a day or two the older flowers around the outside edge of the patch withered, and then successively those more recently exposed. Thus, a narrow advancing border of flowers always followed the retreating snow.

Monday morning, the 26th May, was cloudy when we left camp near the village of Nawe. The mules moved slowly, and when we had gone about five miles and were passing over a low-lying tract of country, the rain-clouds suddenly burst upon us. A torrential downpour came on with cracks of thunder and great streaks and flashes of lightning. Hail too fell, and the mules turned tail to the storm and could scarcely be persuaded to go on. For a mile around the plain was soon well under water, and further on a river, in flood and impassable, forced us to retrace our steps to the nearest village.

There we arrived drenched to the skin and were glad to accept the hospitality of a Kurdish house where, with an open fire in the centre of a small, ill-ventilated room, and with tears in our eyes from the smoke, we listened to wild Kurdish songs and partook of the inevitable tea; a party of seventeen, all told, with servants, mule-teers, escort and our hosts. It was interesting to find among the Kurds the legend of the Mandrake. A plant, they said, was



uprooted by means of a rope tied to it and to the tail of a sheep, and as its roots were severed it uttered painful groans.

Next morning we were able to ford the stream, and left the Plain of Mergavar by a narrow valley, scantily wooded with walnut and willow. As we ascended, the valley became narrower and steeper and in several places was difficult for the mules to negotiate. After about two hours we got through to more open ground, still climbing, until we were among snowdrifts, and then after following the crest of a range of hills we descended slightly and pitched camp on the edge of the Plain of Gilashe. From our camp I climbed further into the hills, passing the point where the stream, which flowed near our tents, had its source in a miniature glacier in a hollow of the hills, where the snow was banked up fifty to sixty feet deep. I climbed almost to the level of the unbroken line of snow which, at this time of year, is at about 9000 ft., but at these higher levels few plants had yet appeared. Among the rocks which capped one of the lesser heights a species of *Ephedra* was growing.

From Gilashe we followed the valley of a stream which led down to Ushnu, but before descending to the town we had a fine panoramic view of the Ushnu Plain, chequered green and black. Fields of young wheat alternated with great squares of land ready ploughed for the planting of tobacco, for which Ushnu is famous. Beyond lay a circle of snow-clad mountains, dividing Persia from Iraq, a gap which was clearly discernible marking the shortest pass to Rowanduz, a two days' journey. A day was spent in Ushnu in an endeavour to dry some of our plants, which were suffering owing to the heavy rains we had experienced.

There are two routes from Urumia to Ushnu, one in the plain and approaching the Lake, the other through the hills as far as Chichu and Tamatar. We chose the second route for our return journey in order that we might pass through a considerable tract of fine forest, of which we had been told by a Persian Government official. The forest, however, turned out to be forest only in the legal sense, and although for fifty or a hundred yards we did walk under the canopy of Walnuts and Willows, the term scrub would have been much more applicable. The "forest" area lay in the lower rocky slopes of the valley formed by a branch of the Baradur Chai, which descends from a plateau near Ainurum, 14 miles to the Urumia plain. The average height of the trees or bushes, which were widely scattered, was 15 to 20 feet, and the commonest plants were *Pyrus Amygdalus* L. and a species of *Prunus*, a small leaved *Acer*, *Crataegus*, *Fraxinus*, *Zelkova*, *Quercus*, *Populus*, and a shrubby barberry. The last part of the way back to Urumia was under a blazing sun along a yellow sun-baked road, with scant vegetation, a sudden change from the bitter cold in the mountains.

The return journey from Urumia to Tabriz was not altogether uneventful. One night was spent near the village of Khantakhite, and I visited the village of Ioshonlu, the name signifying "full of

Ioshon " or *Artemisia*. Next day in endeavouring to ford the river near Khoi, the bridge having been washed away, we stuck in the middle of the stream and had to be rescued by a team of buffaloes. Water reached the top of the bonnet of the engine and unfortunately damaged some of our specimens in a box at the bottom of the lorry. The following day, when again held up by floods, we made use of the railway line and crossed a bridge in our lorry over the sleepers. We arrived back in Tabriz on June 8th.

From Tabriz excursions were made to the Sahend Range, where we camped near the village of Zinjinab, and to the vicinity of Yam, Mr. Gilliat-Smith accompanying me on both occasions.

#### TABRIZ TO ASTARA.

The longest excursion, however, was to Astara on the Caspian Sea, a distance of just under 200 miles. The road to Teheran is followed for 25 miles, when the track leading to Astara bends to the left along the shores of the freshwater lake at Yusufabad. In configuration the country is again a series of undulating plateaus at different levels, separated by steep ranges of hills. To the north lies Savalan, the second highest mountain in Persia. Beyond Zorab a good many species, hitherto not seen, were collected, and there were many more grasses than occurred in the vegetation of the country further west. It was on this journey, owing to the track being deep in mud, that we spent the greater part of a day covering a distance of four miles. From Ardabil the plateau extends eastwards for fifteen miles, then there is a drop of 5000 ft., to the Caspian Sea. On the plateau the annual rainfall is probably not more than 12 inches, whereas on the slopes which face the Caspian it is as much as 70 or 80 inches, an increase which is naturally reflected by a sudden change in the vegetation. Before descending, there is a short rise to the top of a narrow range which fringes the plateau, and within half a mile of the top the semi-arid and herbaceous vegetation of the plateau is replaced by scattered shrubs four to five feet high.

A hawthorn and a rose are at first common, with scrubby oaks, elms and *Prunus* when the rainfall becomes heavier. On the Caspian side of the ridge the upper slopes are heavily grazed and there are considerable patches of open grassland, but scattered shrubs, sometimes with bracken (*Pteridium aquilinum* L., 1633) in between, continue some distance downwards. The first group of trees on the more gradual slopes are 500 ft. below the crest of the range.

When the mist which enveloped the summit had been left behind the view was magnificent and, as the car bumped over the ill-laid cobble stones or reversed to round one of the many hairpin bends, we looked far down upon a wide vista of wooded mountains. Range after range runs steeply down to the distant Caspian.

On the higher slopes the forest is partially destroyed by grazing, and there are open, light grassy-green spaces, but lower down the dense evergreen forest entirely covers the mountain sides. Here and there a splash of yellow marks a ripening wheat crop, or a

solitary house may be seen with slanting roof, the planks held down by large stones, as in Tibet. Far in the distance is the narrow plain of Astara with the deep blue sea beyond.

Some twelve miles above Astara in a corry where two streams meet, and within a stone's throw of the Russian frontier, we pitched our tents. Steep mountains, clothed in dark green forest, hemmed in the small plateau we had chosen for our halting place. By the roadside and in the forest common species of ferns such as *Dryopteris Filix-mas* Schott., *Phyllitis Scolopendrium* Newm. (1650), *Asplenium Adiantum-nigrum* L. (1636), and *Polystichum aculeatum* Schott. were seen by us for the first time in Persia and in the undergrowth the *Ruscus*-like *Danäe racemosa* Moench. (1673) was also common. The principal trees in the forest were *Acer insigne* Boiss. & Buhse and *A. laetum* C. A. Mey. (1656), *Fagus orientalis* Lipsky (1666), *Zelkova crenata* Desf. (1668), *Tilia rubra* DC. (1655), *Prunus* sp., *Euonymus latifolius* Scop., *Albizzia Julibrissin* Willd. and *Ilex Aquifolium* L. (1648).

As the plains of the Caspian are approached the valley widens and flooded rice fields occupy the flatter ground. The road at length emerges from the hills and the dense well-grazed scrub which fringes the lower edge of the forest gives place to cultivation. The remaining four miles of the way to Astara lie through "bunded" rice and wheat fields. We camped on the seashore, where the sand is dotted with wild pomegranate bushes (*Punica Granatum* L.) which were just in flower.

#### TABRIZ TO BATUM.

This was our last excursion in Persia, and on returning to Tabriz we had to pack, dispose of the lorry and despatch our collections of dried plants, bulbs, seeds, photographs, and kit; for we were advised to take little with us, as our route homeward lay through Russia, from Djulfa to Tiflis and thence to Batum.

At Tiflis, Professor Sosnofsky showed me round the Botanic Gardens, which are very pleasantly situated on a steep slope with subsidiary ridges and ravines. The more recently made part of the garden is the most interesting, as the various types of natural forest in Georgia have been reproduced by careful arrangement in planting and tending.

In Batum also I visited the Botanic Garden, which lies about seven miles from the city on a hillside looking down to the Black Sea. Here plants are arranged in geographical areas. To me the most interesting feature of the surrounding country was the extraordinary resemblance in the exotic vegetation to that of parts of the Darjeeling District of India. Large areas of tea had been planted and *Cryptomeria japonica* D. Don. (introduced to Darjeeling about 1864), was widely planted here also. *Hydrangea* sp. and masses of bamboo (*Arundinaria* sp.) in the undergrowth added to the similarity, while occasional fine examples of *Cupressus funebris* Endl.,



*Pinus longifolia* Roxb., *Picea morinda* Link., and *Araucaria Bidwillii* Hook. further strengthened the resemblance.

From Batum I travelled, through the courtesy of Captain Pool, on a British oil tanker to Constantinople, thence by Vienna and Paris, arriving again in London on the 27th July, 1929.

## VIII. A NEW STINKWOOD FROM EAST AFRICA. J. HUTCHINSON AND MARION B. MOSS.

The genus *Ocotea* is represented in tropical and subtropical America by a very large number of species. In Africa and the African islands there are very few, most of them occurring in the Mascarene Islands. The African species are, however, of very great economic importance. In the *Kew Bulletin* for 1919, pp. 153-164, one of us gave an account of the Rain-tree of Hierro, in the Canary Islands, under the name *Oreodaphne foetens* Nees. This tree is by some considered to be an *Ocotea* (*O. foetens* Webb & Berthel.). The Cape Stinkwood, *Ocotea bullata*, is, of course, a well-known timber tree of South Africa, and occurs in the forests of Knysna as far north as Natal,\* according to Sim.† As is often the case with a common and well-known timber tree, the material, even at Kew, is far from adequate and needs supplementing in order to show the range of variation of the leaves of mature and young shoots and of saplings, and further material of flowers and fruits is also required.

The only species hitherto known from East Tropical Africa is *Ocotea usambarensis* Engl., which ranges from Mt. Kenya and the Aberdares as far south as the Kinga Mountains in the Kyimbila District of Tanganyika Territory. A drawing and description of this species was published by Dr. Stapf in Hooker's *Icones Plantarum*, t. 2934, whilst an account of its very valuable timber was given by the late Sir D. E. Hutchins in *Colonial Reports, Miscellaneous*, No. 41, p. 18 (1907). In East Africa it is spoken of as the East African "Camphor," the Kikuyu native name being "Mozaiti."

Unknown to Hutchins, however, besides good material of this camphor tree, he also sent a leaf specimen of another species, here described. He actually distinguished it by a different native name "Muzura," marking it as "equal to the Cape Stinkwood" with which he was naturally very familiar. Ample material now supplied by Mr. H. M. Gardner, Conservator of Forests, Kenya, has enabled us to recognise the presence of this very distinct species in the East African forests.

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\* A leaf-specimen from Houtbosch in the Transvaal seems to be rather different from the Knysna plant, and a study of the Transvaal plant is desirable. It may represent a distinct species, its leaves being very like those of the species here described.

† Sim, *Forest Flora of Cape Colony*, 289 (1907).



*Ocotea Gardneri* Hutch. & M. B. Moss. A, flowering shoot. B, outer stamen and calyx-lobe. C, lower surface of leaf. D, flower and bract. E, pistil.

**Ocotea Gardneri** *Hutch. et M. B. Moss*, sp. nov.; inter species africanas ob folia magna late vel ovato-elliptica reticulata, petiolos breves, inflorescentias terminales valde distincta.

*Arbor* magna, trunco stricto et cylindrico; ramuli foliferi breves, breviter appresse pubescentes, internodiis circiter 1 cm. longis. *Folia* alterna, late elliptica vel ovato-elliptica, basi rotundata vel subacuta, apice obtusa, 11–14 cm. longa, 6–9 cm. lata, integra, rigide coriacea, utrinque costa media excepta glabra et conspicue et crebre reticulata, supra nitidula, nervis lateralibus utrinsecus circiter 9 marginem versus evanidis furcatis et ramosis; petioli circiter 1.3 cm. longi, supra latissime canaliculati, infra sicco sulcati et breviter pubescentes. *Paniculae* terminales, breves et pauciflorae, ubique breviter pubescentes; bractae deciduae, late triangulares, usque ad 4 mm. longae, carinatae; pedicelli 2 mm. longi, crassi. *Receptaculum* basi late turbinatum, 2 mm. longum, calycis lobis 6 ovatis obtusis 2.5 mm. longis 2 mm. latis marginem versus glabrescentibus. *Stamina* fertilia 9; filamenta brevissima; antherae late ellipticae, 4-locellatae, locellis per paria superpositis; staminodia late triangularia, carnea, glabra. *Ovarium* superum, globosum, glabrum, stylo 1.5 mm. longo, stigmate depresso-globoso. *Fructus* non visus.

TROPICAL AFRICA. Kenya Colony: Ramusambi River, 2600 m., *H. M. Gardner* 1885 (type.); Mt. Kenya, lower forests, *Hutchins.*

Mr. Gardner describes the tree as large, with straight cylindrical bole, said to produce good timber; flowers cream-coloured; rain-fall in the district 50 inches.

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## IX.—THE KAROO GARDEN AT WHITEHILL. R. H. COMPTON.

Professor R. H. Compton, Director of the National Botanic Gardens of South Africa has, at my request, kindly sent the following interesting account of the Karoo Garden at Whitehill for publication in the *Kew Bulletin*.

This Garden is of very great scientific interest to Botanists not only in the Union of South Africa, but throughout the world, and also, owing to the exclusion of animals, is yielding results of considerable value to agriculturists in the more arid regions. It is to be hoped that adequate financial support may be forthcoming to enable this valuable enterprise to be carried on in a thoroughly efficient manner.

The Trustees of the National Botanic Gardens are to be congratulated on having received this splendid bequest of forty acres in the Western Karoo, and the botanical world is greatly indebted to Professor Compton for the able way in which he is developing the area, and taking due care to preserve the native character.

A. W. H.



The physical and climatic conditions of the Union of South Africa are so varied, and the flora is so rich and of so many distinct physiological types that no single botanic garden can be expected to provide perfect habitats for every species. Kirstenbosch, near Cape Town, the headquarters of the National Botanic Gardens of South Africa, probably fulfils the main requirements better than any other site that could be chosen. It is situated in the South West Cape coastal belt, the richest area floristically in the country: and it is therefore favourably placed for the cultivation of the large numbers of Proteaceae, Ericaceae, Iridaceae and other highly interesting and beautiful plants for which the Cape flora is renowned. At the same time, its mild climate, absence of frost and of extreme heat, generous rainfall and reliability of water supply and its variety of soils, altitudes and aspects, make it possible to grow large numbers of species from very distinct associations all over South Africa. Add to this the scenic magnificence of its site, and its proximity to the city and port of Cape Town, it is clear that Kirstenbosch has the fundamentals of a botanic garden not only national but international in its importance. Its chief feature being that it primarily concerns itself with the indigenous plants of South Africa, renders Kirstenbosch of unique interest to the visiting botanist and of special value for the intensive systematic study of the flora.

At the same time it has always been clear that in order to provide optimum cultural conditions for a varied flora, a chain of gardens should be established in a variety of climates, to supplement the work of Kirstenbosch. The most obvious need was a garden in an arid climate to provide for the cultivation of that vast section of the South African flora native to habitats with, say, less than 10 inches of rain annually. A site was accordingly chosen in 1920 at Whitehill, near Matjesfontein in the Western Karoo, forty acres of land being presented to the Trustees of the National Botanic Gardens by the late Mr. J. D. Logan. The site adjoins the railway station and has a frontage of half a mile along the main line from Cape Town to Johannesburg. The distance from Cape Town is 198 miles by rail, and the Garden is thus reasonably accessible.

At the outset the area was enclosed by a goat-proof fence, but owing to financial difficulties it was not possible to undertake regular work for some years. In 1925, however, Mr. J. Archer, an enthusiastic collector and grower of succulent plants, was appointed Curator and steady development began. A water system was installed, paths were laid out and a geographical system of arrangement was adopted, different parts of the Garden being allocated for material from the different areas of the Union and South West Africa:

The Karoo Garden lies on Dwyka Conglomerate rocks (a glacial tillite), with inclusions of massive quartzite. The flora of this type

of country is usually rich,\* and in the Garden site itself a large number of interesting species are included. Except for path making, the plants growing in open formation in the enclosure have not been removed, specimens brought from outside being planted amongst them. In this way there has been a minimum disturbance of the ground and the general aspect of the Garden remains natural: another result is that there are practically no weeds, which means a great saving of labour and expense. The soil is generally shallow, but the rock formation provides innumerable pockets and crevices in which small succulent plants find suitable homes. Large specimens have sometimes to be accommodated in holes blasted out with dynamite.

The rainfall at Whitehill has been recorded for only a few years, which have been actually years of drought; it is probable however, that the average over a long series would be about 5 inches per annum. This falls chiefly in winter, June to August, and in consequence the vegetation shows similar seasonal features to that of the South-Western Cape coastal districts. During the summer the greater part of the flora exists in a resting condition, high temperatures (frequently reaching and exceeding 100° F. in January-April), coinciding with an extreme dryness of soil and atmosphere, which prevents vegetative activity. If an inch or two of rain falls in May or June the succulent plants swell out and grow, innumerable seeds of annual plants germinate and the deep-rooting shrubs commence growth shortly afterwards. In a very few weeks flowers appear, and should there be a further rainfall remarkable colour effects may be produced in September and October, the numerous species of *Mesembryanthemum* and allied genera taking the chief part in this display.

The Garden lies at an altitude of about 2900 feet above sea level, and this combined with the distance from the coast results in great differences between the day and night temperatures. Sharp frosts occur frequently during the winter nights, though the days are usually bright and warm; it is remarkable that in this season of active growth the night frosts rarely cause any injury to the plants.†

The arid districts of South Africa in which there is a winter rainfall, for instance, the south-west corner of the S.W. African Protectorate, Little Namaqualand, the Western Karoo, the Little Karoo and the Robertson Karoo, are those in which the majority of species of succulent plants are to be found; and Whitehill is therefore well situated for the purpose of a Karoo Garden. With suitable

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\* I have collected approximately 400 species of flowering plants and ferns in the Garden enclosure or in the immediate vicinity on Karoo rocks. It may be mentioned that on the Witteberg mountains, a range of hard sandstone 3 miles away, a totally distinct flora occurs, belonging to the "Cape" type.

R.H.C.

† For a general account of Karoo vegetation, with special reference to the Whitehill area, see an article by the author in "the Botanical Features of the South Western Cape Province," Speciality Press, Cape Town, 1929.

R.H.C.

PLATE III



Karoo Garden, Whitehill. In the foreground *Aloe ferox*, *A. microstigma*;  
Witteberg Mountains in the distance.



Karoo Garden, Whitehill. *Pleiospilos Bolusii*, *Euphorbia obesa*, *Gasteria* sp.





attention many of the succulent plants of summer-rainfall districts also succeed in cultivation at Whitehill.

Chief attention has been given at the Karoo Garden to the succulent flora, in which South Africa is so amazingly rich. Efforts are being made to collect as many indigenous species as possible of this type and also to propagate them. In many instances succulent plants have been kindly contributed by correspondents, as has been the case at Kirstenbosch. The South African Railways very generously convey botanical specimens free to Whitehill, and in various other ways have been of great assistance to the Garden.

As an indication of the content of the Garden in succulent plants some of the principal genera may be mentioned. Among the Liliaceae there are numerous species of *Aloe*, *Gasteria*, *Haworthia* and *Apfria*. The Aizoaceae include a very large number of species of Mesembryeae, special attention being given to the so-called "stemless" types belonging to such genera as *Pleiospilos*, *Didymaotus*, *Gibbacum*, *Fenestraria*, *Lithops*, *Conophytum*, *Muiria*, *Frithia*, *Punctillaria*, *Cheiridopsis*, *Faucaria*, *Rhynophyllum*, etc.; and a large number of shrubby and trailing species are also grown. The Portulacaceae are represented by species of *Anacampsenis* and *Portulacaria*. The Crassulaceae include a host of Crassulas and Cotyledons; and it may be mentioned that no fewer than 32 species of *Crassula* and 13 species of *Cotyledon* are actually native to the Whitehill Karoo. Among the Geraniaceae are several succulent-stemmed species of *Pelargonium* and *Sarcocaulon*. There are eight local succulent species of *Euphorbia* and a large number of others have been introduced. Succulent Asclepiadaceae are richly represented in the Whitehill district by species of *Stapelia*, *Caralluma*, *Huernia*, *Piранthus*, *Pectinaria*, *Dudalia* and *Trichocaulon*; and many other species of these and other genera such as *Hoodia*, *Tararcisia* and *Sarcostemma* have been successfully planted. Apocynaceae are represented by the remarkable *Pachypodium namaquanum*, a difficult subject which has been successfully established; Vitaceae by thick-stemmed *Cissus* spp. from S. W. Africa; Dioscoreaceae by species of *Testudinaria*; Zygophyllaceae by *Augea capensis*. Finally the Compositae are represented by many succulent species of *Senecio*, *Kleinia* and *Othonna*.

The propagation of most of these species is carried out both by seeds and by cuttings. It is found that the seeds of the majority of the succulents are set abundantly without special attention and give copious and rapid germination. From a single capsule of a *Pleiospilos* or a *Didymaotus*, a hundred seedlings frequently result. The absence of weeds greatly facilitates these and other gardening operations. Cuttings give equally successful results in most cases, even in such difficult subjects as *Trichocaulon* and *Hoodia*; and such plants as *Gasteria* and some Crassulaceae can readily be propagated by leaf-cuttings.

In the planting of the Garden every effort is made to secure a natural and informal appearance. The site is a natural rock garden,

and any tendency to rectilinear planting is strictly avoided. The requirements of each species are studied as far as possible with regard to aspect, shelter and the season for watering. The species are fully labelled and their localities and names of the donors are also given.

An interchange of plants takes place between Whitehill and Kirstenbosch to the advantage of both gardens. The work of determining the plants grown at Whitehill is undertaken by the Bolus Herbarium (University of Cape Town), situated at Kirstenbosch; and a considerable number of new species, especially of Mesembryaceae, have already resulted.

Another aspect of the Karoo Garden is that, owing to its enclosure, the effects of the grazing of sheep, goats and donkeys, which are so marked on the karoo veld outside, are obviated in the Garden area. The result is that many species which are rarely able to produce full-length shoots or to flower under the conditions which obtain outside the fence do so freely inside. About one-third of the area is kept as a small 'Nature Reserve,' no plants being either removed thence or planted therein; and the contrast between it and the grazed karoo outside is noteworthy. The edible species of plants which are usually prevented by grazing from setting seed, are able to do so within the enclosure; and the idea of a "seed-camp," adopted by some progressive stock-farmers, thus receives a practical demonstration at Whitehill.

During the meetings of the British Association in South Africa in 1929 an excursion to Whitehill was organised for the Botanical Section, and many visiting botanists were thus enabled to make acquaintance with the Karoo vegetation.

In conclusion a few words may be said about the finance of the Karoo Garden. From the outset it has been supported entirely by private subscriptions. Its funds are kept separate from those of Kirstenbosch, and no public body makes any contribution to its support. The result is that progress is slow and the future precarious. There is no building on the spot, and the Curator is compelled to live at Matjesfontein, four miles away. The provision of adequate funds is the chief necessity for the continued existence and development of what may be regarded as a uniquely interesting experiment in botanic gardening.

## X.—ADDITIONS TO THE FLORA OF BORNEO.

H. N. RIDLEY.

### LINACEAE.

#### *Ixonanthes reticulata* Jack.

SARAWAK. Banjermassin, Motley 26. "A large tree with hard white wood: flowers greenish."

*Ixonanthes grandifolia* Ridley sp. nov.; ab *I. reticulata* Jack, cui affinis, foliis multo majoribus rigidioribus differt.

*Arbor* glabra. *Folia* rigide coriacea late obovata apice rotundata saepe retusa basibus angustatis, nervis 12-paribus reticulationibus



laxis, 9-13 cm. longis 5-9.5 cm. latis, *petiolis* 1-2 cm. longis. *Flores* in cyma densa ramis 5 mm. longis, *pedunculo* 5-11 cm. longo validi, *sepalis* oblongis obtusis costatis 2 mm. longis, *petalis* coriaceis obovato-oblongis costatis 5 mm. longis, *staminibus* 10 capilliformibus 2 cm. longis, *stylo* gracili 2.5 cm. longo. *Capsula* oblonga acuta 5-valvata 2.5 cm. longa, *seminibus* anguste oblanceolatis 1 cm. longis, ala 1 cm. longa 3 mm. lata.

BRITISH NORTH BORNEO: *Beccari* 3674; Port Myburgh, Sandakan and Gaya (type), *Creagh*.

This species is distinguished by its very large stiffly coriaceous obovate leaves and few rather large flowers in the head.

***Ixonanthes multiflora*** Stapf ms. sp. nov.; ab *I. reticulata* Jack, cui affinis, foliis obtusis, floribus minoribus densis, capsulis minoribus obtusis distincta.

*Arbor*. *Folia* elliptica vel oblanceolata obtusa apicibus rotundatis basibus cuneatis, 5-15 cm. longa 3.5-8 cm. lata, nervis 6-8-paribus utroque latere elevatis reticulationibus conspicuis, *petiolis* 2-3 cm. longis superne canaliculatis. *Cyma* densa multiflora 2-3 cm. longa et aequae lata, *pedunculo* 7-8.5 cm. longo valido, *floribus* parvis, *pedicellis* 1 mm. longis, *sepalis* ovatis rotundatis 2 mm. longis, *petalis* oblongis truncatis 3 mm. longis, *staminibus* 10 brevibus 4 mm. longis. *Capsula* oblonga obtusa 1.5 mm. longa.

"BORNEO": *Teysmann* 10864. SARAWAK: near Kuching, *Haviland* 1979; *Haviland and Hose* 3384, 3385 (type), 3386.

As in all species of *Ixonanthes* the leaves vary a good deal in size according to the age of the branches. This species is allied to *I. reticulata* Jack, but differs in the form of the leaf, smaller flowers, denser inflorescences and short blunt capsules.

#### OXALIDACEAE.

***Biophytum sensitivum*** L.

SARAWAK: Banjermassin, *Motley* 399.

***Connaropsis (Sarcotheca) grandiflora*** Ridley sp. nov.; a *C. Griffithii*, cui affinis, foliis tenuioribus floribus multo majoribus differt.

*Arbor* parva ramulis velutino-puberulis. *Folia* bijuga petiolis 1 cm. longis glabris basibus incrassatis, *foliis* chartaceis subtus glaucis elliptico-lanceolatis cuspidatis, inferioribus 6.5 cm. longis 3.5 cm. latis, terminali 11 cm. longo 5 cm. lato, nervis 3-paribus gracilibus subtus elevatis, marginibus undulatis, *petiolulis* incrassatis 5 mm. longis. *Panicula* terminalis 5 cm. longa pubescens ramulis 1 cm. longis vel brevioribus, *bracteis* lanceolatis acutis 1 mm. longis, *pedicellis* pubescentibus 5 mm. longis, *sepalis* ovatis obtusis subtruncatis glabris kermesinis 3 mm. longis, *petalis* atro-kermesinis oblongis 1 cm. longis obtusis, *staminibus* brevioribus filamentis filiformibus, *stylo* hirtio quadrifido. *Bacca* subglobosa.

SARAWAK: Kuching, *Haviland* 1786. "Small tree."

This species is distinct in the thinner leaflets, the two lower ones much smaller than the upper, and the large flowers.

#### OCHNACEAE.

*Ouratea angustifolia* (Vahl) Baill. (*Gomphia angustifolia* Vahl) is not a native of the Malay regions; it was based on one of Koenig's Indian plants. The Philippine plant so labelled is quite different. I have not seen the specimens quoted by Merrill for *O. angustifolia* but doubtless the identification is incorrect.

*Ouratea sumatrana* Jack, given as Bornean by King, is also an error.

***Ouratea borneënsis* Van Tiegh.** This is based on two specimens of Beccari's, one of which, no. 3138, I have seen. It appears to be common in Borneo.

SARAWAK: Saribas, Paku, *Haviland and Hose* 3179; Banjer-massin, *Motley* 823; Pontianak, Sungei Kantu, *Beccari* 3414. BRITISH NORTH BORNEO: Marop, *Beccari* 3138; Sandakan, *Mrs. Clemens* 9519, 9438.

Motley describes it as a small tree with yellowish white flowers. Van Tieghem also describes the petals as white, which is unusual in the genus. The leaves are never denticulate as they are in the true *O. angustifolia* (Vahl) Baill. and in *O. oblongifolia* Ridl. of the Malay Peninsula.

***Ouratea megacarpa* Ridley sp. nov.**; ab *O. sumatrana* Hook. fil., cui affinis, foliis coriaceis integris, drupis multo majoribus distincta.

*Frutex* glabra. *Folia* coriacea lanceolata acuminata acuta haud denticulata basibus attenuatis, 10–25 cm. longa 4–7.5 cm. lata, nervis plurimis, intramarginalibus 2, altero 1 mm. altero 5 mm. a margine remotis, reticulationibus minutis, marginibus undulatis, *petiolis* crassiusculis 2–5 mm. longis. *Panicula* laxa elongata 15 cm. longa validula ramis paucis remotis 2–6, *floribus* remotis 2–4 in glomerulis, *bracteis* 1 mm. longis papyraceis lanceolatis vel ovatis carinatis, marginibus denticulatis, *pedicellis* gracilibus 1–1.5 cm. longis, *sepalis* elliptico-lanceolatis acutis 7 mm. longis, *petalis* obovato-oblongis 1 cm. longis, *staminibus* acutis 5 mm. longis; *drupis* reniformibus crassis 1 cm. longis 8 mm. latis cyaneis, sepalis persistentibus haud deflexis.

SARAWAK: Matang, *Ridley* (type); Sepudang, *Haviland*; Rejang, Belaga, *Haviland* 2130; Santubong, *Haviland*: Upper Baram, Gunong Temabok, *Moulton* 6665. BRITISH NORTH BORNEO: Sandakan, *Creagh*.

This plant has the largest leaves and fruit of any Asiatic species. It is nearly allied to *O. sumatrana* Hook. fil. but the leaves are more coriaceous and entire, with very small close reticulations, and the drupes much larger. From *O. neriifolia* Van Tieghem it differs in the shorter more branched panicle and blunt sepals.

**Schuermansia borneënsis** Ridley sp. nov.; a *S. elegante* Bl. differt foliis lanceolatis petiolatis, staminodiis brevibus spathulatis, antheris oblongis obtusis distincte bilocularibus cum cuspidate intermedia.

*Arbor* parva glabra. *Folia* membranacea elliptica obtusa apice rotundato vel retuso, basibus angustatis, 16-18 cm. longa 7-7.5 cm. lata, costa crassa elevata, nervis parallelis tenuibus copiosissimis, *petiolis* crassiusculis 5 cm. longis. *Panicula* 20 cm. longa 16 cm. lata, *floribus* dissitis 4 mm. latis, *pedicellis* 2 mm. longis, *sepalis* 5 ovatis acutis 2 mm. longis, *petalis* oblongo-obovatis obtusis contortis 4 mm. longis, *staminodiis* compluribus spathulatis 1 mm. longis, *staminibus* 5 superantibus, filamentis brevibus antheris oblongis obtusis, apice abrupte acuto, 2 mm. longis, *pistillo* conico in stylum attenuato petalis paullo brevioribus; *capsula* immatura e basi angustata superne dilatata subabrupte cuspidata acuta 1 cm. longa.

SARAWAK: Braang, 1400 ft., *Haviland* 500. "Small tree."

This is the furthest westerly species of this genus, which is mainly found from Papua to Amboina. It differs from most species in having lanceolate petiolate leaves, but there is a fruiting specimen of a plant from Amboina (*Robinson* 2036) which resembles it, both in foliage and in the form of the fruit. From *S. elegans* Blume it differs, besides in the foliage, in the short spathulate staminodes and in the oblong anthers with a sharp central point between the two cells. Indeed in this point it differs from all species I have seen, or of which the flowers have been described.

#### RUTACEAE.

**Evodia alba** Hook. fil.

SARAWAK: Beccari 471; Limbang, *Haviland* 559.

**Evodia robusta** Hook. fil.

SARAWAK: Kuching, Ridley 12270. BRITISH NORTH BORNEO: Sandakan, *Elmer* 20100.

**Evodia malayana** Ridley.

SARAWAK: *Haviland* 559a.

This I suppose is what Merrill calls "*E. lunu-ankenda* (Gaertn.) comb. nov."\*, a Ceylon plant entirely differing from anything in the Malay region. What Hooker calls *E. Roxburghiana* (which Merrill gives as a synonym) is another species again. *E. malayana* is certainly near *E. aromatica* Bl. (*E. Marambong* Miq.) but that is described as a tree, which this is certainly not, being only a bush.

**Evodia triphylla** DC. var. **pubescens** Ridl. var. nov., paniculis elongatis laxis pubescentibus.

BRITISH NORTH BORNEO: East Coast, *Creagh*. SARAWAK: Banjermassin, *Motley* 681. Flowers white; common. Malay name "Sampahon," a medicinal plant with natives; appears to have some trifling tonic properties.

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\* Based upon *Fagara Lunu-ankenda* Gaertn.



The type of this species is a Philippine plant which differs from the Bornean one in the panicle branches being glabrous whereas those of the latter are distinctly pubescent. The panicles too in the latter plant are much elongated and spreading, in those of Creagh's specimen as much as 15 cm. long; in fact the whole plant is much bigger. The flowers of both appear to me to be identical.

**Evodia concinna** Ridley sp. nov.; ab *E. aromatica* Bl., cui affinis, foliolis ellipticis obtusis laevibus, panícula laxa foliis brevior, sepalis glabris distincta.

*Arbor parva. Folia* triphylla glabra membranacea, petiolis 3-3.5 cm. longis puberulis, *foliolis* ellipticis obtusis (junioribus pubescentibus), 5-9 cm. longis 2.5-3.2 cm. latis subaequalibus, nervis gracilibus 10 vix elevatis reticulationibus laxis, petiolulis 2 mm. longis. *Panicula* 9-12 cm. longa laxa, pedunculo 4.5-8 cm. longo, ramis 2-5 cm. longis pubescentibus, *floribus* albis, *pedicellis* 2 mm. longis pubescentibus, *bracteis* minutis linearibus pubescentibus, *sepalis* ovato-rotundatis liberis 1 mm. longis, *petalis* ovatis obtusis 2 mm. longis, *staminum* filamentis crassis subaequilongis antheris oblongis majusculis, *disco* hirto, *stylo* glabro crasso breve.

SARAWAK: Mt. Buan, limestone, *Haviland* 2039. "Small tree, petals white."

Perhaps nearest to *E. aromatica* Bl., from which the small blunt leaves smooth above, the whitish pubescence on the petiole and peduncle, and the lax branched panicle, at once separate it.

**Evodia obtusifolia** Ridley sp. nov.; ab *E. glabra* Bl., cui affinis, foliis multo minoribus obovatis apicibus rotundatis, floribus minoribus, staminibus petala multo superantibus differt.

*Arbor?* *Folia* triphylla, petiolis validis 5-6.5 cm. longis, scabro-pubescentibus, *foliolis* obovatis vel ellipticis obtusis glabris coriaceo-membranaceis, 6-9.5 cm. longis 4-6 cm. latis, apicibus rotundatis ad bases cuneatis, nervis subtus elevatis 8-9-paribus, petiolulis lateralibus .5 mm. terminali 1 cm. longis. *Paniculae* breves compactae 5-7 cm. longae pubescentes, *pedicellis* 2 mm. longis, *sepalis* ovatis 1 mm. longis, *petalis* oblongo-ellipticis obtusis 2 mm. longis, *staminibus* longioribus 3 mm. longis filamentis gracilibus antheris ellipticis, *disco* hirto.

SARAWAK: Baram, *Hose* 512.

**Tetractomia parviflora** Ridley sp. nov.; a *T. Beccarii* Hook. fil., cui affinis, floribus multo minoribus copiosis, coccis parvis, distincta.

*Arbor parva. Folia* coriacea rigida oblongo-obovata rarius lanceolata obtusa vel breviter subacuta basi acuminata, 9-15 cm. longa 5.5-7 cm. lata, nervis tenuibus usque 13-paribus, costa subtus elevata, petiolis 5 cm. longis. *Paniculae* subterminales multiflorae patentes 3-7 cm. longae, *pedunculis* 1.5 cm. longis ramis pedicellisque puberulis, *bracteis* minutis lanceolatis acutis puberulis, *floribus* parvis 2 mm. diametro viridibus, *pedicellis* 1 mm. longis, *sepalis* ovatis puberulis, *petalis* ovatis obtusis vel acutiusculis, *staminibus*

brevioribus filamentis planis superne attenuatis; *coccis* oblongis obtusis 5 mm. longis 2 mm. latis.

SARAWAK: near Kuching, *Haviland* 2842, 2243 (type); *Haviland and Hose* 3359. "Small tree; flowers green; ovary sunk inside the disc, 4-celled, with 2 collateral ovules in each cell."

Allied to *T. Beccarii* Hook. fil., but the flowers and fruit are about half the size, and the flowers are much more numerous in a number of subterminal panicles, which are shorter than the leaves.

***Tetractomia latifolia*** Ridley sp. nov.; a *T. Beccarii* Hook. fil., cui affinis, foliis multo majoribus coriaceis, nervis paucioribus, floribus minoribus omnino glabris differt.

*Arbor parva. Folia* opposita coriacea obovata vel oblonga abrupte acute cuspidato-acuminata, basibus attenuatis, 9.5-17 cm. longa 7-9 cm. lata, nervis tenuibus 8-paribus intra margines in-arcuantibus, costa subtus elevata, *petiolis* crassis superne dilatatis 2-3.5 cm. longis. *Paniculae* usque 7 cm. longae ramis et pedicellis pubescentibus, *floribus* viridibus congestis, *pedicellis* 2 mm. longis, *sepalis* 4 ovatis acutis 2 mm. longis, *petalis* 4 triangularibus acutis 3 mm. longis, *staminibus fertilibus* 4 filamentis planis superne attenuatis, *staminodiis* 4, disco glabro, *stylo* 3 mm. longo, stigmatibus obscure lobato; *fructu* biccoco, *coccis* lanceolatis 1 cm. longis 3 cm. latis acutis.

SARAWAK: Kuching, *Haviland* 2140 (type); *Haviland and Hose* 3358. "Small tree, flowers green."

This differs from *T. Beccarii* Hook. fil. in the larger more coriaceous leaves with fewer nerves and smaller quite glabrous flowers.

***Tetractomia montana*** Ridley sp. nov.; foliis parvis spathulatis, floribus 3 majusculis in cymis axillaribus ab omnibus differt.

*Arbor parva glabra. Folia* spathulata, apicibus rotundatis basibus gradatim attenuatis, 4 cm. longa 1.5 cm. lata, nervis obscuris tenuibus 5-paribus, margine incrassato, *petiolis* 4 mm. longis. *Cymae* axillares triflorae, *pedicellis* 4 mm. longis, *sepalis* brevibus rotundatis, *petalis* triangulari-ovatis acutis viridibus 2 mm. longis, *staminibus* 4 aequilongis filamentis a basi attenuatis, *staminodiis* 4; *coccis* 2 oblongis obtusis 5 mm. longis 3 mm. latis, *seminibus* oblongis 2 mm. longis, *alis* 3 mm. longis 2 mm. latis inaequilateralibus ovatis obtusis, basi unilateraliter productis.

SARAWAK: Mt. Bongo, near Tegora, *Haviland* 2050. "Small tree, flower green."

***Glycosmis***. Merrill in his list gives only one species, *G. cochinchinensis* (Lour.) Pierre, under which he includes such different species as *G. pentaphylla* Correa and *G. citrifolia* Lindl. The genus has been revised lately by T. Tanaka, with whose identifications in the Kew Herbarium I cannot always agree.

***Glycosmis citrifolia*** Lindl.

SARAWAK: *Beccarii* 1759; Banjermassin, *Motley* 271. BRITISH NORTH BORNEO: Kudat, *Fraser* 75. "Small shrub; flowers white, fruit translucent flesh-coloured."

**Glycosmis chlorosperma Spr.**

SARAWAK : *Haviland* 616 ; *Beccari* 772 ; Kuching, *Haviland and Hose* 616 ("Flowers pale green, stamens 10") and 3727 ; Niah, on limestone, *Haviland and Hose* 3666. BRITISH NORTH BORNEO : Tuahang Gunong, near Kudat, *Fraser* 142 ; Sandakan, *Elmer* 20186.

Most of these specimens are of the compact many-flowered paniced form.

**Glycosmis cyanocarpa Spr.**

SARAWAK : Banjermassin, *Motley* 381.

**Glycosmis Oliveri** *Stapf* ms. sp. nov. ; floribus in panícula valida maximis ab omnibus distincta. A *G. chlorosperma* Spr. differt foliis minoribus, floribus majoribus.

*Frutex* glaber. *Folia* uni- vel bijuga 18 cm. longa, *foliolis* ellipticis acuminato-cuspidatis obtusis, 7-12 cm. longis 3-5 cm. latis, nervis 5-paribus subtus elevatis, *petiolis* 5 mm. longis. *Panicula* subterminalis validula rufo-furfuracea 5 cm. longa, ramis inferioribus 2 cm. longis, *bracteis* furfuraceis triangulari-ovatis acutis 1 mm. longis, *pedicellis* 2 mm. longis crassis, *sepalis* 5 ovatis rotundatis, *petalis* 5 oblongis obtusis glandulosis 5 mm. longis intus puberulis, *staminibus* 10, filamentis crassis 1 mm. longis, antheris lanceolatis 2 mm. longis.

SARAWAK : *Beccari* 2595.

This is totally unlike any other species in its very large flowers.

BURSERACEAE.

**Canarium parciflorum** *Ridley* sp. nov. ; nulli arcte affinis, omnino glabra paniculis brevibus paucifloris, floribus parvis, distincta.

*Arbor* glabra. *Folia* 1-2-juga, 15 cm. longa, *foliolis* coriaceis ellipticis vel oblongis cuspidato-acuminatis, basibus rotundatis, 9-12.5 cm. longis 4-8 cm. latis, nervis 8-paribus superne inconspicuis subtus elevatis, nervulis tenuibus irregularibus, *petiolulis* 1 cm. longis ad basin et apicem incrassatis. *Paniculae* parvae breves pauciramiosae pauciflorae 3 cm. longae, *pedicellis* 1 mm. longis, *calyce* patelliformi 1 mm. longo margine sinuato, *petalis* ovatis obtusis 2 mm. longis, *staminibus* 6 petalis brevioribus extra discum ortis, antheris ellipticis.

SARAWAK : near Kuching, *Haviland* 2878.

I can find nothing quite like this plant. It is remarkable for its very short panicles with only 2 branches at the base, the upper flowers being in pairs on the terminal branch. The whole plant appears to be quite glabrous.

**Canarium pauciflorum** *Ridley* sp. nov. ; affinis *C. Kipella* Miq., foliis bijugis, petalis longioribus, staminibus ad bases haud dilatatis differt.

*Arbor* glabra. *Folia* 1-2-juga 30 cm. longa (*petiolo* 9 cm. longo) glabra, *foliolis* ovatis vel lanceolatis cuspidatis 10-12 cm. longis 4-5.5 cm. latis, basibus acuminatis nervis 9-paribus subtus elevatis,



nervulis haud parallelis irregularibus reticulationibus subtus conspicuis, *petiolulis* 5 mm. longis crassis rugosis. *Paniculae* puberulae 5–9 cm. longae, ramis superne brevibus 1 cm. longis vel brevioribus, inferioribus 5 cm. longis paucifloris, *floribus* subsessilibus, *pedicellis* 1 mm. longis vel brevioribus, *calyce* urniformi subglabro 2 mm. longo margine undulato, *petalis* 3 triplo longioribus sericeis oblongis, *staminibus* 3, filamentis antheris longioribus, basibus haud dilatatis, *disco* glabro.

SARAWAK : Kuching, *Haviland* 1864 (type) ; *Haviland and Hose* 3181.

Allied to *C. Kipella* Miq., but the leaves have only 2 pairs of leaflets, the petals are longer and the stamens not dilated at the base.

### ***Canarium caudatum* King.**

SARAWAK : Kuching, *Haviland* 2877. "Flowers yellow."

The flowers are rather smaller than in the type from the Malay Peninsula and the calyx is often quite entire, but it is otherwise the same. I found it also in Sumatra on the Kelantan river in Siak.

***Canarium flavum* Ridley sp. nov. ; a *C. secundo* Benn., cui affinis, floribus multo minoribus calyce integro distincta.**

*Arbor.* *Folia* trijuga 13–18 cm. longa, *foliolis* ovatis acuminatis basibus rotundatis superne laevibus glabris subtus minute hirtis, 5.5–9 cm. longis 3–4 cm. latis, nervis superne depressis subtus elevatis 11-paribus, nervulis transversis elevatis, reticulationibus conspicuis, *petiolulis* 3 mm. longis. *Paniculae* 15–18 cm. longae pubescentes ramis 2–5.5 cm. longis paucifloris remotis rufo-tomentosis recurvis, *floribus* sessilibus, *bracteis* parvis ovatis rufo-tomentosis, *calyce* urniformi tomentoso viridi 3 mm. longo, margine integro vel undulato, *petalis* 6 mm. longis oblongis obtusis sericeis, *staminibus* 3 e disco ortis 3 mm. longis, *disco* glabro lobato, *ovarum* rudimento conico.

SARAWAK : Kuching, *Haviland* 2850. "Calyx green, corolla yellow."

Certainly allied to *C. secundum* Benn., but the flowers are very much smaller.

***Canarium latistipulatum* Ridley sp. nov. ; a *C. legitimo* Miq., cui affinis, foliis denticulatis, stipulis latis squamiformibus denticulatis distincta.**

*Arbor parva.* *Folia* 5-juga 30 cm. longa, *stipulis* orbiculari-ovatis coriaceis denticulatis 2 cm. longis 1.7 cm. latis, *foliolis* elliptico-oblongis cuspidatis basibus cuneatis marginibus denticulatis, subcoriaceis glabris, 7–13 cm. longis 4.5–5.2 cm. latis, nervis 10-paribus subtus elevatis nervulis transversis subtus conspicuis reticulationibus minutis copiosis, *petiolulis* 1 cm. longis, *stipellis* 2 ad basin 5 mm. longis obovatis. *Paniculae* puberulae 15–29 cm. longae laxae, ramis remotis 2–10 cm. longis, *floribus* subsessilibus in glomerulis, *bracteis* minutis lanceolato-acuminatis caducis, *calyce* rufescente urniformi dentibus 3 acutis sericeo-pubescente 3 mm. longo 4 mm. lato,

*petalis* 8 mm. longis oblanceolato-oblongis obtusis sericeis flavis, *staminibus* 6 liberis *petalis* brevioribus.

SARAWAK: near Kuching, *Haviland* 2245. "Small tree; calyx reddish, corolla yellow."

This species, of which I have only male flowers, seems most nearly allied to *C. legitimum* Miq. but has by no means entire leaves, for they are conspicuously toothed especially on the long cusp. The stipules at the base of the leaves are very broad, rounded and toothed. Above the basal ones are two smaller ones and a pair at the bases of the branches of the long panicle. The flowers are crowded in tufts of 4 to 7 at the ends of the branches, which are 3 cm. apart.

**Canarium micrantherum** Stapf MS. sp. nov.; affinis *C. rubiginoso* Benn. sed foliis pilosis, foliolis subtus hirtis, nervis pluribus, petiolulis brevioribus, *petalis* glabris differt.

*Arbor. Folia* 4-juga 22-27 cm. longa hirta, *foliolis* elliptico-oblongis coriaceis cuspidatis basibus rotundatis, 10-12 cm. longis 4.5-6.5 cm. latis, nervis 20-paribus subtus elevatis pilosis, costa superne et subtus pilosa, *petiolulis* 5-7 mm. longis. *Panicula* 20 cm. longa pilosa, ramis 2-5.5 cm. longis, ramulis 5 mm. longis densifloris, *pedicellis* 1 mm. longis, *bracteis* oblongis pilosis, *calyce* patelliformi parvo hirtulo, *petalis* 3 ovatis 2 mm. longis, *staminibus* 4 brevioribus in disco infra marginem insertis,  *pistillodio* immerso.

SARAWAK: Kuching, *Haviland* 1889.

This is allied to *C. rubiginosum* Benn. but the leaflets are longer, hairy beneath and on the midrib above, the petiolules are longer, and the petals are quite glabrous, not silky hairy as in *C. rubiginosum*.

**Canarium fusco-calycinum** Stapf MS. sp. nov.; *C. Vrieseano* Engl. approximata, sed foliolis brevioribus ovato-lanceolatis usque oblongo-lanceolatis, *calyce* tubuloso subglabro differt.

*Arbor* ramis pilosis. *Folia* 2-3-juga, *petiolis* hirtis, *foliolis* rigide coriaceis oblongo-lanceolatis vel ovato-lanceolatis acuminatis basibus rotundatis vel breviter cuneatis (siccis virescentibus), 7.5-11 cm. longis 4-6 cm. latis, nervis 10-12-paribus subtus cum nervulis transversis et reticulationibus elevatis hirtis, costa superne hirta, *petiolulis* hirtis 5 mm. longis. *Paniculae* 12-15 cm. longae, ramis paucis dissitis hirtis, *floribus* subsessilibus (alabastris ellipticis), *bracteis* ovatis acutis hirtis ferme 1 mm. longis, *calyce* cylindrico 4 mm. longo puberulo trilobo, lobis ovatis intus sericeis, *petalis* 3 oblongis paullo longioribus sericeis, *staminibus* 6 in tubum brevem connatis.

SARAWAK: Kuching, *Haviland* 1981.

Perhaps most nearly allied to *C. Vrieseanum* Engl., but the leaflets are ovate-lanceolate, much shorter, and the calyx nearly glabrous.

**Canarium costatum** Ridley comb. nov.; *Santiria costata* Benn. in Hook. fil. Fl. Brit. Ind. i. 537.

SARAWAK : *Beccari* 240.

The fruits of a specimen of Kunstler's collected at Gunong Bubu, Perak, Malay Peninsula, are undoubtedly those of a *Canarium*. They are oblong, 1.6 cm. long and 1 cm. in diameter. I transfer this plant therefore to the genus *Canarium*.

***Canarium Moultonii*** Ridley sp. nov. ; affinis *C. costato* (Benn.) Ridley sed haud ferrugineo-tomentosa, calyce distincte tubuloso petalisque pubescentibus differt.

*Arbor* ramis furfuraceo-pubescentibus. *Folia* bijuga, *petiolis* pubescentibus 4 cm. longis, *foliis* coriaceis lanceolatis cuspidatis cuspe obtusa 1 cm. longa basibus angustatis obtusis, glabris superne nitidis, 10-13 cm. longis 4-6 cm. latis, nervis 8-paribus valde elevatis, nervulis transversis paucis irregularibus, costa elevata ad basin furfuraceo-pubescente, *petiolulis* 1 cm. longis furfuraceo-pubescentibus ad apices incrassatis. *Paniculae* laxae pauciramosae pubescentes 8 cm. longae foliis breviores, *floribus* singulatim dissitis parvis, *bracteis* lanceolatis acutis pubescentibus parvis, *pedicellis* 2 mm. longis pubescentibus, *calyce* campanulato trilobo, lobis ovatis, pubescente 1 mm. longo, *petalis* 2 mm. longis ovatis obtusis extra pubescentibus, *staminibus* 3 e disco ortis, *ovario* conico glabro, *stigmatibus* magno trilobo.

SARAWAK: Gunong Tenabok, Upper Baram, 3000 ft., *Moulton* 6767.

This species is allied to *C. costatum*, but it is not ferrugino-tomentose in any part, only palely stiffly pubescent ; the calyx is deeply lobed and the petals ovate, silky pubescent ; the pedicels of the flowers are shorter and the leaves are not finely reticulate.

***Canarium expansum*** Ridley sp. nov. ; nulli arcte affinis, ab omnibus differt petalis tenuibus haud coriaceis expansis vel reflexis, staminibus longioribus erectis.

*Arbor* parva. *Alabastra* rufo-furfuracea. *Folia* 4-juga glabra, *foliis* coriaceis oblongo-lanceolatis cuspidato-acuminatis basibus cuneatis, 21 cm. longis 7.5 cm. latis, nervis 10-paribus superne depressis reticulationibus majusculis, *petiolulis* 3 cm. longis ad apices et bases incrassatis et transverse rugosis. *Paniculae* laxae 18 cm. longae ramis remotis 2-9 cm. longis, *floribus* pallide viridibus, *pedicellis* 7 mm. longis, *calyce* campanulato breviter trilobo 2 mm. longo, *petalis* tenuibus oblongis obtusis expansis 4 mm. longis, *staminibus* 6 extra discum glabrum ortis filamentis elongatis linearibus antheris oblongis brevioribus.

SARAWAK: Kuching, *Haviland* 2271. "Small tree ; perianth pale green, disc yellow."

This is quite unlike anything known to me. The petals are quite thin and spread out in flower, being almost reflexed, while the long stamens stand erect.

***Canarium reticulatum*** Ridley sp. nov. ; affinis *C. Kadondon* Benn. sed panicula multo longiore floribusque multo majoribus differt.—*C. rostriferum* Miq. var. *cuspidatum* Engl. in DC. Mon. Phan. iv. 137.



*Arbor* ramis crassis. *Folia* 3-5-juga glabra, 45 cm. longa, *petiolis* validis 15 cm. longis inclusis, *foliolis* coriaceis ellipticis usque ovato-ellipticis breviter acutis vel cuspidatis cuspidate 1.5 cm. longa 12-13 cm. longis, 6-7 cm. latis, basibus latis vel angustatis, nervis 11-paribus subtus elevatis superne tenuibus, nervulis transversis subtus elevatis, reticulationibus minutis in utraque pagina conspicuis, *petiolulis* 1-1.5 cm. longis. *Paniculae* 15-30 cm. longae ramis 4-8 cm. longis dissitis ramulis 3 cm. longis ferrugineo-pubescentibus, *pedicellis* 2-3 mm. longis, *calyce* cupulato hirtio trilobo 1 mm. longo; *petalis* ovato-rotundatis hirtis 2 mm. longis, *staminibus* brevibus, filamentis antheris longioribus. *Drupe* 3 cm. longa oblique oblonga.

SARAWAK: Beccari 2909, 2176; Miri river, Hose 677.

Engler referred Beccari's specimen 2176 to a variety of *C. rostriferum* Miq.—var. *cuspidatum* Engl. (*Dracontomelum cuspidatum* Bl. Mus. Bot. Lugd. Bat. i. 232). *C. rostriferum* Miq. is only known from leaf specimens collected by Teysmann in the Lampongs, Sumatra, and is entirely different from Beccari's plant. The *Dracontomelum cuspidatum* Bl. was also based on a leaf specimen which I have not seen. The description is very incomplete and it is impossible to guess what Blume had before him, but from what description there is it was certainly not *C. reticulatum* Ridl. nor *C. rostriferum* Miq. Merrill has called Engler's plant *C. cuspidatum* (Bl.) nov. comb. Engler's description of the flowers of the *C. rostriferum* in DC. l.c. is taken from those of *C. reticulatum* Ridl., i.e. from Beccari's specimens.

The species is allied to *C. Kadondon* Benn., but the panicle is much longer and the flowers larger. It resembles *C. hirtipetalum* Ridl. in general habit, but the glabrous leaves finely reticulate on both sides, and round (not oblong) white hairy petals distinguish it from that.

**Canarium hirtipetalum** Ridley sp. nov.; affinis *C. reticulato* Ridl., sed nervis magis prominulis et subtus hirtis, furfuraceo-rufescentibus, nervulis transversis conspicuis, petalis oblongis subtruncatis dense appresse albo-hirtis distincta.

*Arbor* ramis validis. *Alabastra* rufo-furfuracea. *Folia* bi- vel trijuga 20 cm. longa, *foliolis* coriaceis ovatis vel oblongo-ovatis, basibus breviter angustatis apicibus acutis, 10-13 cm. longis 4.5-5.5 cm. latis, superne glabris costa immersa stellatim albo-hirsuta, subtus nervis cum costa rufescenti-furfuraceis albo-pilosis 10-13-paribus elevatis, *petiolulis* 1 cm. longis subtus pilosiusculis. *Panicula* valida 20 cm. longa, *pedunculo* 8 cm. longo albo-pubescente, ramis 3-8 cm. longis, *floribus* in apicibus ramulorum congestis, *pedicellis* 2 mm. longis, *calyce* ferme ad basin in lobos ovatos tres rufescenti-scabridos fisso, *petalis* vix longioribus oblongis obtusis albo-pubescentibus, *staminibus* 3 brevioribus extra discum ortis.

SARAWAK: Baram, Haviland and Hose 3183.

Allied to *C. reticulatum* Ridl., but the nerves are more prominent and hairy beneath with rufescent scurf, the transverse nervules conspicuous, the petals oblong subtruncate and densely covered with white appressed hairs longest on the keel.

**Santiria mollissima** Ridley sp. nov. ; affinis *S. multiflorae* Benn., sed foliis bijugis, foliolis ovatis cuspidatis, floribus paucioribus in paniculis laxis, recedit.

*Arbor* ramis hirtis. *Folia* bijuga 18 cm. longa, *petiolis* 4-6 cm. longis villosis, *foliolis* ovatis vel ellipticis cuspidatis basibus rotundatis vel breviter acuminatis, superne glabris costa villosa excepta, subtus in nervis reticulationibusque hirtis, 6-15 cm. longis 4-9 cm. latis (cuspidate 5 mm.-1 cm. longa), nervis 8-9-paribus prope margines inarcuantibus, *petiolulis* 5 mm.-1 cm. longis hirtis. *Paniculae* graciles 7-15 cm. longae ramis 5-6 remotis brevibus 1 cm. longis, *floribus* viridibus paucis in cymulis, omnino hirtis superne viscidis, *pedicellis* 1 mm. longis, *calyce* cupuliformi obscure trilobo hirtis, *petalis* 3 ovatis parce hirtulis 2 mm. longis, *staminibus* 6 in disco ; *drupa* elliptica glabra inaequilaterali 1 cm. longa.

SARAWAK : Kuching, *Haviland* 1819. "Flowers green, petals 3, valvate. Stamens 6, seated on disc. Ovary 1 carpel with 1 ovule."

Allied to *S. multiflora* Benn. which it much resembles in the flowers, but the leaflets are fewer and widely ovate, not oblong narrow, the whole plant more hairy and the panicles slender, lax and few-flowered.

**Santiria Havilandii** Ridley sp. nov. ; affinis *S. montana* Bl. sed foliis haud minute reticulatis cuspidate brevioribus haud ad apicem dilatata, floribus paniculisque minoribus, calyce majore trilobo petalisque brevioribus differt.

*Arbor* ramulis puberulis. *Folia* 2-3-juga, 28 cm. longa, *foliolis* coriaceis oblongis cuspidato-acuminatis basibus angustatis, glabris costa in utraque pagina puberula excepta, 6-12 cm. longis 4-5 cm. latis, nervis tenuibus 12-13-paribus nervulis intermediis ferme aequae conspicuis intra margines arcuantibus, *petiolulis* puberulis 1 cm. longis ad apices incrassatis. *Paniculae* complures pubescentes rufescentes 5-12 cm. longae ramis brevibus compluribus, *floribus* 3-4 in apicibus congestis, *bracteis* minutis lanceolatis pubescentibus, *pedicellis* 1 mm. longis, *calyce* cupulato trilobo lobis rotundatis 1 mm. longis, *petalis* ovatis rotundatis 2 mm. longis pubescentibus, *staminibus* 3 brevioribus, filamentis brevibus antheris subglobosis.

SARAWAK : Kuching, *Haviland* 1821. "Inflorescence reddish, disc yellow." Rejang River, Sibul, *Haviland* (type).

Near *S. montana* Bl. of Borneo and Sumatra, but the leaves are not minutely reticulate as in that species nor have they a long cusp dilated at the tip ; the flowers and panicles are smaller, the calyx proportionally larger, distinctly 3-lobed, and the petals shorter.

**Santiria latifolia** Stapf ms. sp. nov. ; affinis *S. oblongifoliae* Bl. sed foliis majoribus ovatis ellipticis crasse coriaceis, floribus majoribus paniculis longis patentibus differt.

*Arbor* parva. *Folia* bijuga, *petiolis* et rhachidibus glabris, *foliolis* rigide coriaceis ovato-ellipticis basibus breviter subacutis apicibus breviter obtuse cuspidatis, superne glabris subtus rufescenti-furfuraceis, 13–18 cm. longis 8.5–11 cm. latis, nervis 9–10-paribus subtus elevatis nervulis transversis conspicuis interruptis reticulationibus conspicuis costa in utraque pagina elevata crassa, *petiolulis* crassis 2.5 cm. longis. *Paniculae* validae patentes scabridae 2.4 cm. longae costatae, ramis remotis 2–3 cm. dissitis 6 cm. longis validulis, ramulis subterminalibus 5 mm. longis scabridis, *pedicellis* 2 mm. longis *calyce* cupulato lobis 3 brevibus rotundatis 1 mm. longis, *petalis* ovatis rotundatis vix longioribus, *staminibus* brevioribus 3.

SARAWAK : Penrissen Road, *Haviland* "c.o.z.z." "Small tree."

A very distinct plant from its large stiff ovate leaflets and wide spreading lax panicle with a stout ribbed peduncle and branches. The indumentum consists of scurf-like minute processes. It is allied to *S. oblongifolia* Bl. but the leaflets differ in their shape, being quite ovate, stiffly coriaceous and much wider.

**Santiria rubra** Ridley sp. nov. ; affinis *S. laevigatae* Bl. sed foliolis crassis coriaceis ovatis, paniculis brevioribus gracilioribus distincta.

*Arbor* magna glabra. *Folia* bijuga, *petiolis* 8–12 cm. longis, *foliolis* coriaceis ovatis cuspidato-acuminatis basibus rotundatis, 13.5–15 cm. longis 7–8 cm. latis, nervis 7-paribus tenuibus inarcuantibus, *petiolulis* 1.5 cm. longis. *Paniculae* axillares multiramosae 12 cm. longae glabrae multiflorae ramulis brevibus tenuibus, *floribus* copiosis, *pedicellis* 2 mm. longis, *calyce* patelliformi obscure trilobo *petalis* rotundatis 2 mm. longis rubris, *staminibus* 6 brevibus extra discum ortis.

SARAWAK : near Kuching, *Haviland* 2269. "Large tree, petals red."

This plant is nearly completely glabrous, the ultimate branches of the panicle being obscurely puberulous only. It is allied to *S. laevigata* Bl. but the leaflets are quite rounded and the panicles shorter and more slender.

**Santiria parviflora** Engl. This is based on Beccari's specimen 3706 which is identical with *Haviland* 922, "Three miles from Kuching," and with 1865 from Rejang, Sib. Engler does not describe the petals, which are short, ovate, blunt and silky pubescent outside. To Beccari's number 3706 he adds a fruiting specimen 3319 to which his description of the drupes of *S. parviflora* appears to belong, but this fruiting specimen belongs to a different though allied plant.

**Santiria pedicellata** Ridley sp. nov. ; a *S. parviflora* Engl. differt floribus omnino glabris pedicellis longis.



*Arbor* glabra. *Folia* trijuga usque 18 cm. longa, *foliolis* oblongis cuspidato-acuminatis obtusis basibus angustatis, 7–11 cm. longis 2–4 cm. latis, nervis tenuibus circiter 15-paribus, nervulis intermediis subaeque conspicuis, *petiolulis* 1 cm. longis crassiusculis. *Paniculae* 7–12 cm. longae laxae ramulis 2 cm. longis, glabris, *floribus* parvis, *pedicellis* 3 mm. longis, *calyce* patelliformi trilobo marginibus ciliatis, *petalis* 3 rotundatis 1 mm. longis, *staminibus* brevibus 3, *petalis* brevioribus, *antheris* globosis e disco ortis, *pistillo* conico brevi, stigmate capitato; *drupa* oblongo-globosa 1 cm. longa in pedicello elongato 1 cm. longo gracili, calyce explanato trilobo lobis rotundatis.

SARAWAK: Sibü, Rejang River, *Haviland* 2374, 1878 and 1866 (type); near Kuching, *Haviland* 2264; *Beccari* 3319.

Very distinct from *S. parviflora* Engl. in its long-pedicelled glabrous flowers. There is a small amount of scurfiness on the young parts of the leaves, rhachis and petiolules, extending sometimes up the costa beneath, but otherwise the foliage is glabrous.

***Santiria minimiflora*** Ridley sp. nov.; a *S. caudatae* Laut., cui affinis, foliis ovato-ellipticis caudatis (nec lanceolato-caudatis), reticulationibus laxis (nec minutis) conspicuis differt.

*Arbor* glabra. *Folia* 8 cm. longa, 2–3-juga, *foliolis* coriaceis ovato-ellipticis caudatis 4.5–5 cm. longis 1.5 cm. latis, nervis tenuibus circiter 15-paribus paullo elevatis, *petiolulis* gracilibus 4 mm. longis. *Paniculae* breves laxae 3 cm. longae, *floribus* minutis 1 mm. longis, alabastris globosis, *pedicellis* 2 mm. longis, *calyce* campanulato lobis 3 rotundatis, *petalis* vix longioribus rotundatis, *staminibus* 3, filamentis brevissimis antheris longioribus subrotundis.

SARAWAK: near Kuching, *Haviland* 1703.

This species is remarkable for its small leaflets and minute flowers. It is certainly closely allied to *S. caudata* Lautenberg of New Guinea. The flowers are very similar, but the leaves of the latter are longer, caudate and very finely reticulate. It differs from *S. pedicellata* Ridl. in its much smaller and more ovate leaves.

***Santiria fasciculata*** Benn.

SARAWAK: Path from Matang to Kuching, *Haviland* 617.

This is the long-leaved and long-panicled form which occurs in Perak.

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## XI.—MISCELLANEOUS NOTES.

**Fifth International Botanical Congress, 1930.**—The Preliminary Programme of the Congress has now been published, and copies may be obtained from the Hon. Secretaries, Mr. F. T. Brooks, Botany School, Cambridge, and Dr. T. F. Chipp, Royal Botanic Gardens, Kew. A summary of the more important features of the Programme is given below.

The Congress will be held at Cambridge from August 16th to August 23rd, under the Presidency of Professor A. C. Seward, F.R.S.

Any person interested in Botany may become a member of the Congress on payment of the subscription of £1. Subscriptions should be paid by 1st April, 1930, to the Hon. Treasurer, Dr. A. B. Rendle, British Museum (Natural History), London, S.W.7. Letters to the Treasurer should be marked "Fifth International Botanical Congress" on the outside.

A reception of members of the Congress will be held at the Imperial Institute, South Kensington, London, S.W.7, at 8.30 p.m. on Friday, August 15th.

Hotel accommodation in London and in Cambridge must be booked by members for themselves, but accommodation in Colleges and houses in Cambridge will be available. Further information on this point is contained in the Preliminary Programme.

#### PROVISIONAL SECTIONAL PROGRAMME.

The Congress will be organised in eight sections (not seven as indicated in *Kew Bulletin*, 1927, p. 224). These sections, with their Presidents and Recorders, are as follows :—

##### SECTION B. BACTERIOLOGY.

President ; Prof. R. E. Buchanan, Department of Bacteriology, Iowa State College, Ames, Iowa, United States.

Recorder ; Mr. E. G. D. Murray, Department of Pathology, Cambridge, England.

##### SECTION E. PHYTOGEOGRAPHY AND ECOLOGY.

President ; Prof. H. C. Cowles, The University, Chicago, United States.

Recorder ; Prof. A. G. Tansley, Department of Botany, Botanic Garden, Oxford, England.

##### SECTION G. GENETICS AND CYTOLOGY.

President ; Prof. O. Rosenberg, Botaniska Institutet, Stockholms Högskola, Stockholm, Sweden.

Recorder ; Prof. R. R. Gates, King's College, Strand, London, W.C.2.

##### SECTION M. MORPHOLOGY (INCLUDING ANATOMY).

President ; Prof. J. C. Schoute, Zuiderpark 2, Groningen, Holland.

Recorder ; Prof. F. E. Fritsch, Danesmount, Tower Hill, Dorking, Surrey, England.

##### SECTION MY. MYCOLOGY AND PLANT PATHOLOGY.

President ; Prof. L. R. Jones, University of Wisconsin, Madison, Wis., United States.

Recorder ; Dr. E. J. Butler, Imperial Bureau of Mycology, 17, Kew Green, Kew, Surrey, England.

#### SECTION P. PLANT PHYSIOLOGY.

President ; Dr. F. F. Blackman, Botany School, Cambridge, England.  
Recorder ; Prof. W. Stiles, Department of Botany, The University,  
Birmingham, England.

#### SECTION PB. PALAEOBOTANY.

President ; Dr. D. H. Scott, East Oakley House, Basingstoke,  
England.  
Recorder ; Dr. H. Hamshaw Thomas, Botany School, Cambridge,  
England.

#### SECTION T. TAXONOMY AND NOMENCLATURE.

President ; Prof. Dr. L. Diels, Botanischer Garten und Botanisches  
Museum, Berlin-Dahlem, Germany.  
Recorder ; Dr. A. W. Hill, Royal Botanic Gardens, Kew, Surrey,  
England.

Communications may be made to the Congress in English,  
French or German.

Abstracts, not exceeding 300 words, of communications to be  
made to the Congress should be sent to the Recorder of the appropriate  
Section by May 1, 1930.

All communications relating to Sectional Programmes should be  
sent to the Recorders. /

The subjects indicated in the Preliminary Programme have  
already been chosen for discussion. Evening lectures of general  
interest will be given. The complete programmes will be issued  
shortly before, or at, the opening of the Congress.

The official opening of the Congress will take place on the  
evening of Saturday, August 16th, 1930.

A number of sectional excursions have been planned for members  
of the various sections, and other general excursions for members as  
a whole are being arranged to take place after the Congress.

Arrangements for attending the Congress may be made with  
Messrs. Thos. Cook & Son, Ltd. (Berkeley Street, London, W.1),  
Messrs. Dean & Dawson, Ltd. (7, Blandford Square, Marylebone,  
London, N.W.1), and The American Express Co. (6, Haymarket,  
London, W.1), and their branches throughout the world have kindly  
promised to facilitate as much as possible the travelling arrange-  
ments of members of the Congress. Messrs. Sir Henry Lunn, Ltd.  
(5, Endsleigh Gardens, Euston, London, W.C.1) have similarly  
promised to assist the travelling arrangements of members of the  
Congress resident in North America and in France.

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**Flora of the Sudan.\***—Although much of the flora of the Eastern  
Sudan was made known to us quite early by the explorations of  
Kotschy, Schweinfurth and others, no account of the flora of the

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\*Flora of the Sudan, by A. F. Broun and R. E. Massey. The Controller,  
Sudan Government Office, Wellington House, Buckingham Gate, London,  
S.W.1, 1929, pp. 502. Price 10s.



Anglo-Egyptian Sudan as a whole has ever been published. This has now been remedied by the almost simultaneous publication of two books, one by Mr. A. F. Broun, formerly Director of Woods and Forests, assisted by Mr. R. E. Massey, the present Government Botanist, and the other by Mrs. G. M. Crowfoot.

As Mr. Broun states in the preface of the *Flora of the Sudan*, mainly compiled from the *Flora of Tropical Africa*, the short descriptions have been adapted from that work. As there are no keys to the genera (except for the grasses) or species, however, their determination will often be difficult to all but the expert with a considerable knowledge of the flora as a whole. The artificial key to the families has been extracted from Hutchinson's *Families of Flowering Plants*, the families being arranged after the sequence adopted in that work and in the *Flora of West Tropical Africa*. When the latter is completed a close floristic comparison will thus be possible between these two vast and interesting regions. A comprehensive list of native names arranged under the various tribal dialects is added to the work. The authors are to be congratulated on the production of a neatly printed handbook which should prove of service to those interested in the flora of the Anglo-Egyptian Sudan.

Mrs. Crowfoot's work\* is a book of illustrations of the flowering plants of the Northern and Central Anglo-Egyptian Sudan. It consists of a number of photographs and of 163 black and white sketches of individual species with floral details. With the aid of these illustrations the visitor to the country should have little difficulty in determining a large number of the commoner species, and Mrs. Crowfoot, by the preparation of this book, has thus greatly increased the usefulness of the descriptive volume by Broun and Massey, for which it is intended to be a companion.

J. H.

**The Fungi of Manitoba.**†—This little book is a welcome new departure in the preparation of regional fungus floras. It is the product of many years work by three well-known Canadian botanists, on the fungi of an area of considerable ecological interest. The combination of plant-pathologist, physiologist and taxonomist has resulted in an interesting general account of the fungi, which will appeal to a much wider public than does the usual bare list of species and localities.

The actual list of species enumerates about two thousand fungi and lichens, 45 of which are new. It is preceded by thirteen sections in which are discussed various aspects of the fungi in the area

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\**Flowering Plants of the Northern and Central Sudan*, by Grace M. Crowfoot, with an introduction by A. F. Broun. The Orphans' Printing Press, Limited, 10 & 12, Broad Street, Leominster, pp. xxv. + 163 illustrations.

†*The Fungi of Manitoba*, by G. R. Bisby, A. H. R. Buller and J. Dearness. Longmans, Green and Co., 1929, pp. viii and 194, 1 map. Price 7s. 6d.

concerned, such as geographical distribution, seasonal prevalence, habitats and the relative numbers of fungi and other groups of plants. At the end are indices to hosts and substrata which will be of great use to the field worker, to whom also the convenient size and clear print will appeal.

There are some cases of inconsistency in methods of citation and a few actual errors, while the names used are sometimes those valid according to the American Code, and sometimes those which follow the International Rules of Nomenclature. In the case of the Operculate Discomycetes the authors have explained that they are following the nomenclature used by Seaver in his recent book, but the origin of other names will not be so obvious to the general reader. It would be advisable, in the event of a second edition, that the list should be revised in this respect.

E.M.W.

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**Orris Root.**—Orris Root of commerce, used at the present time in the perfumery industry and in the preparation of toilet articles and dentifrices, consists of the dried rhizomes of three species of *Iris*, chiefly *I. pallida* Lam. and *I. florentina* L., and to a less extent *I. germanica* L. The Florentine hills in Tuscany are the chief source of production of the root, San Polo being the centre of the Tuscan industry. Cultivation is also carried on in other European countries and in Morocco and parts of Kashmir. Owing to less perfect methods of drying, however, the product from most of these countries is generally inferior to the Florentine article. *Iris pallida* yields the finest root and constitutes the bulk of the "Florentine" orris root of commerce.

Great care is exercised in the type of soil chosen for the cultivation of orris root, for soil conditions are liable to have a profound bearing on the nature and quality of the roots. With very rich or heavily manured soils, the roots, though well developed, are prone to possess little or no fragrance and to shrivel considerably on drying, which renders them almost valueless. In very loose sandy soils the roots are found to be lacking in compactness and to possess less odour. The stony mountain soils of Florence are well adapted to the successful growth of the crop. Deep ploughing and careful preparation of the soil are regarded as essential for good results. A spring green-manuring crop to precede planting is recommended. Planting is carried out in Tuscany in August or September, or possibly October, rhizomes being planted about 16 inches apart in rows, approximately 80,000 plants going to the acre. Growth commences almost immediately and the plants are kept well weeded and the ground is periodically hoed. It is not until the second or third year from planting that the rhizomes reach a suitable state for harvesting. In the fresh state they are almost odourless, but the characteristic violet odour soon develops on drying. Irrigation is regarded as more harmful than beneficial, as a tendency for the rhizomes to rot

is set up by it, and the rhizomes from moist soils are generally inferior to those from drier situations.

The usual period for harvesting mature rhizomes is soon after the withering of the flowers, and commences generally in August. In harvesting the rhizomes are dug up with a fork, freed of adherent soil as much as possible, and carted to a shed or shelter to be peeled. The quantity of rhizomes dug in any one day is never more than can be peeled in the following day, for the fresh roots quickly deteriorate if any lapse of time occurs between harvesting and peeling and drying. The peeling of the rhizomes, which is done by hand with a special knife, is a laborious and tedious process in which men, women, and children of all ages take part. To facilitate peeling the rhizomes are first immersed in water. Owing to the variable and fantastic shapes of the rhizomes no type of machinery has yet been devised that can be substituted for hand-peeling. After decorticating the roots are well washed and then sun-dried for a period of five to eight days. In drying the roots are spread on matting consisting of thin bamboo rods strung together and placed on wooden stages about eighteen inches from the ground. Means are provided for protection in the event of rain. The roots are not allowed to dry completely in the sun but are taken indoors and spread on a cool, dry, tiled floor for the final drying, which generally takes another five to eight days. Though every care is taken to keep the roots clean they are sifted after the final drying to remove any foreign matter that might be present. This is followed by a final picking over in which the roots are sorted into qualities, a task calling for no small amount of judgment and patience. As the odour of the root is reputed to improve with keeping, the prepared product is frequently stored for some time before being put to actual use.

Though rarely employed in medicine at the present time orris root was at one time commonly used for its curative properties. Its use in perfumery and medicine can be traced to very early times. In Eastern European countries, to which the plant is native, its properties and uses were well known to the Ancients. It is recorded as in use in England as a perfume for linen as far back as the fifteenth century. In the Georgian period it was a common constituent of hair powders and when mixed with starch constituted what was known as violet powder. Pieces of the root specially shaped were at one time commonly used for infants when teething, and "Issue Beads," small spherical pieces of the root, placed in open wounds for a time to keep them healthy and cause quick healing. A custom in former times was to place a piece of orris root in home-brewed beer to prevent it becoming stale. Wines and brandies were perfumed with it in like manner.

The violet-like odour of orris root is due to the presence of the ketone *Irone*. Towards the end of last century, *Ionone*, a substance with an odour even more like that of violets than *Irone*, was discovered. It grew to be largely used in the perfumery trade in



making toilet waters and handkerchief extracts. It was thought by many that this synthetic substance, which can be produced comparatively cheaply, would entirely take the place of orris root in commerce. This has, however, never occurred, and at the present time quite a keen demand exists for orris root, as the following statement indicates. "The rise witnessed for nearly two years in the price of orris roots still continues this year, and has reached a level that nobody dared to predict. In effect, the roots cost from 15 to 16 francs per kilo, and they are very difficult to obtain. This advance, which has had its repercussion on the price of the concrete and absolute orris oils, has necessarily restricted the consumption of these products which are, however, of the utmost importance in perfumery."\*

F.N.H.

**A Textbook of Tropical Agriculture.**†—The first English edition of this work appeared in 1892, an earlier edition having been published by the Government of Jamaica in the previous year. Since then much has happened in agricultural research in the tropics, and a great extension of cultivation of economic plants beyond their original habitat has occurred. Moreover most British Colonies have now progressive Agricultural Departments with native assistants and learners requiring guidance. An up-to-date revision was therefore long overdue, and this has been ably carried out by Mr. Holland.

The work is divided into two parts. Part i presents the Elements of Agriculture, and includes chapters on soils as the pioneer finds them, and soils as the wise agriculturist treats and improves them, and on plant physiology and its applications in propagation by practical methods both natural and artificial (budding, grafting, etc.). Brief chapters on climate, irrigation, &c., are supplemented by references to modern sources of information, a useful feature appended to most of the chapters throughout the revised edition.

Part ii deals with Agricultural Products. There are five new chapters on fodder plants (demanded by the development of stock-breeding in the tropics), rubber, fibres and oils—fixed and volatile. Several fruits (grape-fruit, avocado, mango, date, &c.) and drugs (camphor, kola, papain, &c.) are dealt with for the first time, as well as pulses amongst the food plants, and the few tanning materials worthy of cultivation in the tropics, gambier, divi-divi and wattle bark.

These additions along with the numerous illustrations—213 as compared with the 16 woodcuts of the original—bring the book up to just twice the size. The illustrations include many photographs taken in the field as well as figures of agricultural implements and machinery for preparing produce.

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\* Perfumery and Essential Oil Record, Oct. 1929, p. 411.

† By H. A. Alford Nicholls, revised by J. H. Holland. Macmillan and Co., Ltd., St. Martin's Street, London, W.C.2, 1929, pp. 639, ill. 213. Price 15s.

Originally intended as a text-book for schools and colleges in the West Indies and for the use of settlers, small-holders, etc., it was adopted more widely. In the preface to the original edition the author claimed that it was not a compilation but a record of experience gained by study, observation and experimental cultivations. It is well, therefore, that the reviser has retained—and judiciously supplemented—the original text, which, with its simple teaching clearly expressed as befits a “guide to the young and unlearned,” kept always practical ends in view. In its enlarged and revised form the book should be a valuable manual for the instruction of learners in the numerous Schools of Agriculture now in being in all our tropical dependencies, and in the elementary Industrial or Junior Trade Schools, as well as of practical help to both European settlers or planters and educated native cultivators anywhere in the tropics.

J.M.D.

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**Mangosteen Shipment.**—During the periods December to March of 1927-28 and 1928-29, trial shipments of Mangosteen fruit (*Garcinia Mangostana* L.) were made from Java to Holland. The trials\* were inaugurated at the instigation of the Commercial Museum of the Colonial Institute at Amsterdam, in co-operation with the Agricultural Department in Java and with shipping companies. The fruit, which had been grown at the Government Fruit Experiment Station at Pasar Minggoe in West Java, was shipped at Batavia and landed at Amsterdam, the voyage occupying approximately 33 days. In all, nine separate shipments of fruit in cold storage were made—four in the first and five in the subsequent season—with various methods of packing.

The first consignment, consisting of four dozen boxes each with 28 fruits packed in coconut fibre and stored at a temperature of  $+3^{\circ}\text{C}$ ., was found to be in quite good condition on arrival at Genoa after 24 days. On arrival at Amsterdam, however, 10-11 days later, the fruit had become over-ripe and had considerably deteriorated. The white flesh of the fruit had become grey-brown in colour with a strong odour of fermentation; while the shell of the fruit, which is normally soft and easily cut with a knife, had become stone-hard. Other methods of packing and of storage were tried with subsequent shipments, but in almost all cases equally disappointing results were obtained. In the last shipment, in which the fruits were first covered with rubber latex before shipment, a slightly higher proportion of sound fruit was obtained.

The conclusion arrived at was that the period taken for the voyage from Java to Holland—nearly 5 weeks—was just too long for successful transportation of the Mangosteen. The trials have

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\* “Beschrijving van enkele verzendingsproeven met manggistans van Java” by Ir. W. Spoor. Berichten van de Afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut, No. 45. (Druk J. H. de Bussy, Amsterdam, 1929.)



shown, however, that this fruit can be successfully shipped over distances necessitating a voyage of even 3-4 weeks without noticeable or appreciable detriment.

The results draw attention to the possibility of the Mangosteen, which is regarded by many as the choicest of tropical fruits, being grown in tropical countries more closely situated to Europe than Java for export to the United Kingdom or European markets. According to a statement by Heyl\* in 1906 occasional small consignments of Mangosteen were despatched from Martinique to France and carried well, the voyage taking 12 days. No mention is made as to the conditions of storage under which the fruit was placed.

F.N.H.

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**The Flora of the Indus Delta.**†—This Flora is now available in book form, being reprinted from the pages of the Journal of the Indian Botanical Society, in which it appeared in parts during the past three years.

The region covered comprises the whole of the Delta of the Indus south of a line drawn through Karachi, an area of about 2500 sq. miles.

The volume starts with a list of the flowering plants collected during a visit by two of the authors, Father Blatter and Mr. McCann. Short notes are given as well as the general distribution of each species and the collection number. Vernacular names are quoted when known. A detailed description of the Physical Aspects of the region follows under the headings:—Water Conditions, Geology, Soil and Climate.

The next part is concerned with Plant-Geographical considerations, in four sections:—Statistical Notes, Geographical Distribution, Origin of the Flora, and Comparison with the vegetation of the Sundribans. The last section was inspired by the statement made by the late Sir J. D. Hooker, in his Sketch of the Flora of British India, that "The Indus Delta repeats the vegetation of the Sundribans of Bengal, with a greatly reduced number of species." At the time this statement was made, and indeed until the work under review was undertaken, a very imperfect knowledge of the vegetation of the Indus Delta was available. The authors disagree with the statement quoted above and demonstrate their view by a list of genera and species indigenous to both areas, which shows a marked divergence, with totals of 279 species for the Indus Delta and 304 in the Sundribans, of which but 52 appear in both areas. Moreover it is to be noted that even now the botanical exploration of the Indus area is less advanced than that of the Sundribans.

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\* Bull. Kol. Museum Haarlem, No. 37, p. 109 (1907).

† By E. Blatter, C. McCann and T. S. Sabnis. The Methodist Publishing House, Madras, for the Indian Botanical Society, 1929, pp. vi. + 173; plates, figs. and graphs 76. Price Rs. 7, 10s., or \$2.50.



A short chapter presents some ecological notes and the last 52 pages are devoted to "descriptive notes of systematic value on the anatomical features" of a number of the plants in the area. This chapter is the work of Mr. Sabnis.

Fifty photographs, many good but some rather poorly reproduced, give a very fair idea of the region and its types of vegetation. There are also 18 graphs elucidating climatic, distributive and ecological factors, and 8 plates of woodcuts from camera lucida drawings of anatomical details to illustrate the last section.

The work is a valuable contribution towards a fuller knowledge of the Indian Flora and some of its problems, and is another contribution in the series of local floras that should eventually cover the whole of the Peninsula.

C.E.C.F.

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**Portrait of Sir David Prain.**—During last summer a very fine tinted crayon portrait of Sir David Prain was executed by Miss F. A. de Biden Footner at the instance of a number of Sir David's friends. The portrait was presented to him in November, and at the same time the desire was expressed that ultimately it might find a permanent home at Kew. Sir David and Lady Prain have most generously acted on the suggestion without delay, and the portrait has now been hung with those of the former Directors of Kew in the waiting room at the Herbarium.

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**A New Textbook of Botany.\***—In the preface to this book the authors say that it is not written for students intending to specialize in Botany, but that it attempts to present the fundamental biological principles to those taking a general course in biology. However, as the book is primarily for American students, many of the examples cited are unknown to British students and also are not readily accessible. In view of this and of the rather unorthodox treatment of the subject matter the book will probably be of more use in America than elsewhere.

The book contains a number of very useful illustrations, the text figures in general being very good, particularly the three-dimensional drawings of anatomical details in perspective, which should prove of great help to the student. The half-tone reproductions, however, appear often to have been made from negatives of poor quality. As far as the format is concerned, the book is an excellent example of modern text-book production.

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\* Botany; a text-book for College and University Students, by W. J. Robbins & H. W. Rickett. Macmillan & Co. Ltd., London, 1929, pp. xxiii. + 535, figs. 384. Price 16s.